THE PROTECTION HANDBOOK

A Guide for Operational Personnel
The Protection Handbook – Version 13.2 – March 2018

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Preface

This Protection Handbook has been created for those people who are encountering the topic of fire safety for the first time. It attempts to provide underpinning knowledge in accordance with relevant UK National Occupational Standards. It should help readers obtain a better understanding of their own fire safety role, duties and responsibilities across a broad spectrum of different premises and fire risks.

The Protection Foundation course which this handbook supports should help fire and rescue service personnel conduct simple Fire Safety Checks within premises to which the Regulatory Reform (Fire Safety) Order 2005 applies. It should also enable them to spot dangerous fire safety conditions and raise awareness of the contribution Protection makes to the built environment, public and firefighter safety, thereby helping to improve operational effectiveness.

Whilst the handbook appears to be a weighty volume, it is hoped that the reader will discover that it is written in a simple, user friendly style and in an accessible format. The handbook provides a little more depth to many of the topics covered by the Protection Foundation course.

When conducting Fire Safety Checks, personnel must be aware of the limits of their own authority and competence. The information provided in this handbook is not intended to empower operational personnel to engage in giving fire safety advice and instructions to occupiers, other than for the most simple and obviously non-contentious matters.

It cannot be over stressed, that personnel must seek advice, or refer to a Protection Officer when they encounter fire safety problems which require deeper analysis and specialist knowledge to resolve.

B Harvey
Fire Safety School Manager
Chapter 1

Basic Fire Theory
Fire Theory

Combustion is a very complex and multifaceted topic. In this handbook, only a very simplified explanation is attempted. For more detailed study, suggested further reading is given at the end of the handbook.

Just about everyone has a simple appreciation of what fire is. To assess the hazards and risks it can present in the built environment, a slightly deeper understanding has to be obtained. Fire involves a chemical reaction between a combustible fuel and an oxidising agent (usually supplied by oxygen in air) which releases heat and light. Most people are familiar with the concept of the triangle of fire consisting of heat, fuel and oxygen.

This simple combustion model is still relevant, but is gradually being replaced with the tetrahedron of fire which requires four elements to be present in order for combustion to take place:

- A source of oxygen. This is usually provided by the surrounding air, but it can sometimes be provided by an oxidising agent, or a direct source, such as pure oxygen in a cylinder or pipe (as may be found in a hospital).

- A fuel to burn (solid, liquid, gas, vapour or dust).

- A heat or ignition source capable of imparting sufficient energy to initiate the combustion reaction. Heat may be transmitted to the fuel via radiation, conduction or convection, via a spark, or even self-heating.

- A self-sustaining chemical chain reaction. This is the combustion process itself.
The addition of the fourth element provides a more complete model and helps to explain why some fires self-extinguish despite heat, fuel and oxygen being present, or how some extinguishing media works (e.g. dry powder, halon, etc.). Take any one of these elements away, and a fire will either not burn, or will go out. This simple fact is essential knowledge for fire prevention, fire risk assessment and fire extinguishment.

What is the combustion process?

Solid carbonaceous fuels consist of atoms arranged together to form a molecular structure. At normal ambient temperatures, the atoms in this structure will be moving relative to each other.

Raising heat levels will cause the atoms to absorb energy and vibrate more vigorously. For solids and liquids, increasing the heat exposure will eventually cause some of the molecular bonds to fracture and molecules, bits of molecules and atoms will be released. This process is called pyrolysis and the molecular “shrapnel” given off can be highly reactive and flammable. These products, along with any water, can usually be seen with the naked eye as light hazy smoke or vapour. These pyrolysis products can ignite, either from an external ignition source, or because they have reached their auto-ignition temperature.

At this point, flaming will occur, with the flame itself consisting of atoms, molecules and free radicals* combining and splitting in many quintillions of reactions (A quintillion is a trillion trillion), all involving an energy exchange (mostly exothermic, or giving off heat) and the production of smoke.

* Free radicals - atoms or molecules with one or more un-paired electrons making them highly chemically reactive.
In essence, the fuel itself does not burn, but decomposes to release flammable gases and particles to feed the flame. The heat from the flame will radiate in all directions and impinge on the surface of the fuel, feeding back thermal energy. If this thermal feedback is sufficient it will increase pyrolysis and sustain the combustion process.

It must be noted that the simple description of the burning of solid fuel does not apply to combustible gases, vapours or suspended dusts. It is a characteristic of these fuels that ignition is easily achieved by relatively low energy ignition sources (such as sparks) and that combustion can take place extremely rapidly without pyrolysis.

A more detailed explanation of these types of fuels is given in following sections.
Physio-Chemical Properties of Fuels

Combustible solids – The combustion of all conventional solid fuels (wood, paper, fabric, plastics, etc.) is reliant on a pyrolysis process as described in the previous section. A general principle is that solid fuels are easier to ignite (assuming normal atmospheric and ambient conditions) if they are present in a finer, thinner form. For example, it is difficult to ignite a large log of wood, but the same wood in the form of thin shavings will be easily ignitable kindling. Understanding this principle will help in the assessment of the fire hazard and risk presented by many different materials in day-to-day use.

Flammable liquids – these give off flammable vapours. The initial production of flammable vapours does not rely on a pyrolysis process but will be dependent on the temperature of the liquid and its volatility. Higher temperatures result in more vapours being produced. At the same temperature, highly volatile liquids such as petrol tend to produce more vapour than less volatile liquids such as diesel or heavy fuel oil (less refined products derived from crude oil).

Knowing the density of the vapour produced relative to air will indicate whether vapours will rise, mix, or fall within any enclosure or space. Ignition of these vapours can occur some distance away from the original liquid source. If the vapour is ignited, the heat radiated back by the flame to the surface of the liquid promotes increasingly rapid production of even more vapour, feeding and growing the flame. Most flammable liquids burn freely and vigorously.

The term flashpoint describes the lowest temperatures at which the vapours can temporarily “flash” when exposed to an ignition source, and the ignition point is the lowest temperature which will sustain ignition once exposed to an ignition source.
The auto-ignition point is the lowest temperature at which a fuel will ignite without the presence of an ignition source.

**Definitions under the EU Classification, Labelling and Packaging of Substances and Mixtures Regulations (No. 1272/2008)**

- Flammable liquids = flashpoint between 21°C and 55°C
- Highly flammable liquids = flashpoint <21°C
- Extremely flammable = flashpoint <0°C and a boiling point of 35°C

It follows that those liquids that produce the most vapours at lower temperatures have the potential to present a higher fire risk if not used, managed or contained safely.

**Flammable gases and vapours** - The ignition of any gas or vapour cloud can cause catastrophic damage. Gases and vapours share many common characteristics. As before, a gas or vapour’s density relative to air will reveal its tendency to rise, mix or fall within a space.

An important factor to take into account is the flammable/explosive range of the gas or vapour.

The Lower Flammable/Explosive Limit (LFL or LEL) is the lowest concentration (%) in air that can support combustion and the Upper Flammable/Explosive Limit (UFL or UEL) is the highest concentration in air that can support combustion.

![LEL UEL diagram](0 % \(\text{LEL}\) 100 % \(\text{UEL}\))

Below the LFL/LEL the mixture will be too lean to burn, and above the UFL/UEL, too rich to burn. Somewhere close to the middle of the range will be the optimum concentration for combustion.
As a general principle, fuels with a wide flammable range tend to present the highest risk. For example, Acetylene gas has a LEL of 2.5% and a UEL of 81% giving it a very wide explosive range.

**Flammable Dusts** – Not many people appreciate that seemingly harmless dusts such as flour, sugar, coal, sawdust, etc. when suspended in air possess similar attributes and combustion characteristics as flammable vapours and gases (including LEL and UEL).

A relatively thin layer of dust covering surfaces in a workplace creates the potential for a dust explosion. A typical scenario will involve the dust being disturbed in some way, allowing it to be suspended in air in sufficient concentration to burn should it encounter a suitable ignition source.

Witnesses to this phenomenon have often described initially hearing a small bang followed shortly by a much bigger bang. This first bang is often a small dust explosion, the blast from which disturbed the rest of the dust lying on other surfaces. This bigger dust cloud can then ignite, causing a much bigger explosion, sometimes totally destroying a building.

**Imperial Sugar, USA**
Dust Explosion 2008
14 killed, 38 injured.

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The Reality of Fire

Fortunately, not many people have any experience of fires within buildings and will have their perception of risk formed by the unrealistic depiction commonly given on television and in the cinema.

Having discussed some basic principles it is worth considering what a real fire can be like. There are four primary factors to take into account that have an impact on human tenability in a fire scenario:

- Time
- Visibility
- Heat
- Smoke toxicity

Time - Fire growth within a room or compartment can be unpredictable, varying from a slow smoulder lasting hours, to a rapid deflagration, over in seconds. However, under normal well-ventilated conditions most fires involving conventional solid fuels grow very quickly. The time to respond to a fire should be measured in seconds and a minute or two at most.

Visibility – Smoke consists of hot fire gases and other products of combustion (vapour droplets, soot particulates, etc.) It is usually thick, black and hot. It will rise in a buoyant plume until it meets an obstruction (usually the ceiling), then it will spread sideways until it meets a wall, where it will drop downwards.
A large room can fill with smoke from the top down so that within a minute or two, clear air may only exist a few inches from the floor. As smoke moves through a building it can cool, dilute with air and increase in volume so that, if unchecked, it can spread quickly and silently into every part of a building. It will block light from windows and interior lights. Expect not to see.

**Heat** - The heat produced by a fire in an enclosed space can be staggering. The rising hot fire gases and particulates (smoke) typically raise temperatures at upper levels to many hundreds of degrees centigrade. Inhaling fire gases at 100°C will scorch the lungs causing immediately life threatening injury, and at 120°C it can cause pain and burns to exposed skin. Thermal radiation at 2.5 KW/m² (2500 Watts) is just bearable, and beyond this burns will occur.

Fires tend to be measured in megawatts. For example, a good sized settee well alight will produce a total heat output of something in the order of 3 MW (3000,000 Watts).

In a compartment, the initial flames, and the smoke itself, radiates heat back to the rest of the contents of the room, initiating further pyrolysis and the production of even more flammable gases from other adjacent items, such as furniture, carpets, etc.

Eventually the room can get so hot (approximately >500°C) that a Flash-Over can occur, where everything not yet burning simultaneously ignites. This can be a rapid and powerful phenomenon. Temperatures will rise to very high levels (>1000°C) in a second or less, and enough force may be generated to blow windows out.
Smoke toxicity – Smoke is a complex and variable mix of hot air, fire gases, steam, pyrolysis and combustion products. Depending on the type of fuels burning and the efficiency of the combustion process, fires will produce a bewildering cocktail of irritant, narcotic and toxic chemicals, all carried in an oxygen depleted smoke.

The following list shows a small sample of chemicals that may be produced:

- Carbon Monoxide
- Carbon Dioxide
- Hydrogen Cyanide
- Hydrochloric acid
- Sulphuric acid
- Nitrogen Dioxide
- Acrolein
- Styrene
- Phenol
- Hydrogen Chloride

Inhaling these products (asleep or awake) can incapacitate in seconds. Survivors describe eyes and lungs stinging and burning, being unable to move, and being very confused, disorientated and unable to think clearly. Seemingly irrational behaviour is not uncommon as the brain succumbs to the chemical attack.

Summary - For all the reasons above and more, it is no wonder that survivors of fire describe it as a very frightening experience.
CHAPTER 2

Introduction to Protection
Benefits of Protection

Saves lives and property.

Positive information and data relating to the number of fires and related injuries, fatalities and costs can be fairly easily assessed. However, it is much more difficult to prove a negative. Who records how many fires do not break out because of fire safety measures taken? Who records how many people successfully escape from a burning building because they had adequate means of escape to use?

When you take in to account that recent surveys have estimated that approximately 75% of small fires are extinguished without calling the Fire and Rescue Service, and then think of the vast numbers of people who escape from fire unaided, it seems more than reasonable to assume that more lives are saved by the fire safety measures taken in buildings, than by Operational personnel carrying out rescues. Protection is low profile and unglamorous, but it is effective.

Property damage by fire can be devastating not only for irreplaceable personal effects but also for commerce. In addition to this vast financial cost, some property can be of historical or cultural interest, or may be vital to society, such as power stations, hospitals, etc.

Protects and assists fire-fighters.

In theory, fire safety measures should mean that fires will be discovered earlier and will therefore be smaller, easier and safer to deal with. Fire safety structural measures should also make a building a more stable and safer environment to fight fire in and can be used in firefighting strategies and tactics. Many buildings have facilities specifically for use by the fire and rescue service, such as firefighting shafts, fire-fighter’s lifts, dry risers, smoke ventilation, etc.
Minimises fire losses and costs to the economy.

Insurance costs are always passed on. There is no such thing as a free lunch! It is notoriously difficult to determine accurately how much fire costs the UK economy. Government and insurance sector estimates often vary, but the Association of British Insurers quoted insured losses of £1051 million in 2013. Un-insured losses will have to be added to this significant sum.

The cost of fires wherever they occur will inevitably become a financial burden on tax payers and insurance customers, either because the property was not insured, or because insurance premiums will be increased. In the private sector, even if adequately insured, many businesses find that the overwhelming disruption a fire can bring and the inevitable loss of custom, leads to bankruptcy or take-over, as competitors move in to take up their market share. The impact on other dependant businesses and the work-force can be devastating.

Environmental protection.

For most fires the immediate environmental damage is obvious i.e. smoke, toxic fumes, release of products which may be dangerous or harmful in large or small quantities, fire-fighting water run-off, etc. These harmful and toxic products of combustion will vary in relation to the fuels involved and how they burn.

In addition to the list of typical chemicals in smoke given in the proceeding chapter, the following list provides a representative sample of pollutants that might be produced from a range of different common fuels:

Oxides of Nitrogen; Hydrogen Sulphide; Sulphur Dioxide; Isocyanates; Ammonia; Hydrogen Fluoride; Hydrogen Bromide; Phosphine; Phosgene; Nitric Oxide; etc.
Some environmental damage is not so immediately obvious e.g. contamination of the site and surrounding land by isocyanates and other persistent toxic organic chemicals after large amounts of plastics have been burnt. Asbestos fall-out may also present hazards and major problems for the authorities who have to clean up afterwards.

Public relations and professional image.

The general public has high expectations of the Fire and Rescue Services expertise in fire safety matters. Despite many well qualified organisations, businesses, specialists and professional individuals sharing in this expertise, in most cases the Government consistently entrusts the fire and rescue services with the overall responsibility for enforcing fire law in the majority of premises.
History of Fire Legislation

You may wonder why it is important to study the history and development of our fire safety legislation. Anyone who has studied the history of fire incidents will know that there is much to learn to inform current and future practice.

"Those who cannot learn from history are doomed to repeat it".

George Santayana, philosopher and poet.

This handbook provides a representative sample of notable incidents which resulted in UK “stable door” legislation or regulation.

Theatre Royal Fire, Exeter, Devon, 1887

During a performance to a packed house a fire broke out backstage and spread to the auditorium very quickly. The exits were insufficient and 188 people died in the resulting chaos. The majority of bodies were found piled up one on top of another just inside the exit doors. It took several days to disentangle the mass. Some bodies were beyond identification and the bodies of other missing persons were never found.

The Home Secretary ordered Captain Massey Shaw to conduct an enquiry into the incident. Recommendations such as properly marked and illuminated exits of sufficient width and number were made, along with others such as safety curtains, regular safety inspections etc. This incident ultimately led to the introduction of the Theatres Act 1888.

* "Stable Door“ – from the expression "shutting the stable door after the horse has bolted"
M & M Mart Garage, Bristol. 1951

Mid-morning in a city centre location, a petrol tanker tried to discharge its load into an underground tank and overfilled it. A spark from nearby electrical apparatus ignited the vapour and caused a huge explosion and running fuel fire, which engulfed workers, passers-by and demolished surrounding buildings. 11 people were killed.

This incident led to amendments of the Petroleum Acts of 1928 and 1936, to tighten up the arrangements for the delivery and transference of petrol.

Eastwood Mills, West Yorkshire. 1956.

These factory premises consisted of three storeys and an attic. It had an internal staircase at one end and an internal flight of stairs between the attic and the third floor at the other (with access to an external stair). The premises held a fire certificate issued under the Factories Act 1951.

The fire was started on the ground floor by a plumber’s blow-lamp. He tried to extinguish the fire but did not raise the alarm. The fire spread rapidly and quickly made the means of escape unusable. The bodies of six women, and one man (found near the head of the stairs) and a boy (found in the lavatory) were recovered the next day.
The enquiry revealed that in the premises there was no fire alarm or exit signs, fire drills or staff training, all of which were required by the fire certificate. The occupiers of this factory were successfully prosecuted under the Act for failure to comply with the requirements of the fire certificate and were fined £15.

At this time, control and enforcement of Factories Act Fire Certificates, was the responsibility of the Local Authority Factory Inspectors. The ratio of inspectors to factories was such that inspections may only be carried out, at best, once in five years. The inspection was not directed solely at fire precautions and the awareness of the Inspectorate to fire safety issues was suspect.

The Home Secretary directed, that responsibility for means of escape should be taken from the Factory Inspectors and transferred to the Fire Authorities who "...by their extensive knowledge of how buildings and their contents behave when on fire, make them admirably suited for this responsibility."

The Factories Act 1951 was duly amended to transfer responsibility for means of escape in certified premises to the Fire Authorities.

**Henderson’s Department Store, Liverpool. 1960**

These premises consisted of a five storey building with basement and sub-basement, having several stairways, only one of which was enclosed. A fire alarm was installed, but at the time of the fire, was not connected to the power supply.

The fire started in faulty electrical cabling between the third and fourth floors.
The doors to the enclosed stairways were held open, allowing smoke to spread through the building. People could not escape because of smoke rapidly filling the store.

On arrival the Fire Brigade found normal trade was being carried out on lower floors because no one was aware of the fire above. Ten people were rescued by firemen, ten died in the fire, including one person awaiting rescue that fell off a ledge.

This incident resulted in the introduction of the Offices, Shops and Railway Premises Act 1963, which made Fire Authorities responsible for the certification of such premises.

Top Storey Club, Bolton, Lancashire. 1961

The club was on the third floor of a converted premises and had a single staircase, unprotected by fire doors. The fire started in the ground floor joinery shop and quickly spread, trapping all those upstairs. 19 people were killed. Some of the victims smashed windows and jumped to their deaths.

The resulting Licensing Act of 1961 enabled fire prevention officers to inspect such premises, on behalf of the Licensing Justices, and make recommendation as regards suitability, necessary alterations and to impose recommendations.
Rose & Crown Hotel, Saffron Walden, Essex. 26th December 1969

The fire broke out at 01:47 hrs. in a TV set in a downstairs lounge and quickly spread due to many doors having been left open.

People trapped upstairs were unaware that an alternative exit was available, due to lack of exit signs. Some guests jumped from upper floors and were seriously injured, others knotted sheets together to climb out of windows. Firemen managed to rescue twelve. Eleven lives were lost.

There had been many reviews of existing fire safety legislation enquiring into the overlap of fire and health and safety matters. In 1970 the Holroyd report made several recommendations in an attempt to anticipate the country’s future fire safety requirements. This led to Parliament passing the first dedicated fire safety legislation, The Fire Precautions Act 1971.

It was a series of hotel fires, culminating in the Rose & Crown incident which led to hotels being the first premises to be designated as requiring a fire certificate under the new Act.

Woolworth’s, Manchester, 1979

The fire started in a furniture storage area of the shop and quickly produced large quantities of toxic smoke. The premises had a current Fire Certificate but the national standards of fire safety at that time had not fully responded to the new fire hazards presented by modern foam filled furniture.
Fire Brigades and consumer groups were aware of the problem and had started a campaign to change the law. There were many subsequent fire deaths (mainly in the home) culminating in the deaths of a father and four children in a semi-detached house fire in Merthyr Tydfil on New Year’s Day 1988. It was this incident that gave the final push to introduce the Furniture & Furnishing Regulations 1988 which amongst other things modified the combustion characteristics of foam upholstery and furniture covers.

**Stardust Discotheque, Dublin, 1981.**

A small fire started in a sloping seating area and very quickly developed into a serious fire. Initially, many guests stood around to watch the doorman’s attempts to fight the small fire.

By the time it became apparent that the fire was not going to be extinguished, the fire’s rapid development was such that very few could escape. 48 lives were lost.

The subsequent enquiry and reconstruction of the incident revealed that the nature of the upholstered seating, its’ layout, ceiling height and the covering on of some of the walls (carpet floor tiles) would lead to an exceptionally fast fire development and flashover.

The repercussions of this research was such that the British Government decided to react to this Irish incident by introducing its own legislation, which introduced Fire Authority involvement with the granting of licenses for such premises i.e. the Local Government (Miscellaneous Provisions) Act 1982.
Bradford City F.C., Valley Parade, West Yorkshire, 1985

The fire started in rubbish under a wooden spectator stand and spread with great rapidity. Most victims were found by the locked exits at the back of the stand. 56 lives were lost.

Along with the Licensing Authority, the Fire Service was criticised for not responding appropriately to complaints that had been made previously about the accumulation of rubbish under the stand.

There had been many football stadia disasters over the decades (not all fires) and many reports recommending remedial measures, none of which had been fully implemented. The post Bradford enquiry by Lord Justice Popplewell emphasised this fact and his report resulted in the passing of the Fire Safety & Safety of Places of Sport Act 1987, and amendments to the Safety of Sports Grounds Act 1975.

The effect of this was also to amend parts of the FP Act 1971 to improve the Fire Authorities power to prohibit the use of premises under section 10 of that Act.

Kings Cross Underground Railway Station, London, 1987

At approximately 19:30, a small fire was noticed under escalator no 4. (The subsequent investigation believes this fire may have been burning for up to 30 minutes before discovery).
The public’s reaction to this was initially quite jovial. However the 30 degree slope of the wooden escalator caused a “trench effect” which created a 25 megawatt blow-lamp of flame travelling at 10m per second. The speed of this fire development and flashover caused the deaths of thirty members of the public and staff, as well as the first attending Officer in Charge.

Poor maintenance and cleaning were discovered to be a contributory factor to the outbreak. These and other safety issues were addressed by the introduction of the Fire Precautions (Sub Surface Railway Station) Regulations 1989, issued under powers conferred to the Secretary of State by section 12 of the FP Act 1971.

**Other incidents**

There are other major incidents that could be described, such as Summerland, Flixborough, etc. There are a large number of other significant or serious fires which did not receive so much individual attention, usually because of their size, or because the casualty count was less.

There is also a vast international experience of major fires with large loss of life, in a wide variety of premises and sites. This handbook cannot reproduce a complete list, but notable incidents include:

- Triangle Shirtwaist Fire, 146 killed, USA 1911
- H. Booth & Son factory, 49 killed, UK 1941
- Coconut Grove Nightclub, 492 killed, USA 1942;
- Beverly Hills Supper Club, 165 killed, USA 1977;
- MGM Grand Hotel, 87 killed, USA, 1980;
- Uphaar cinema fire, 59 killed, India, 1997;
- Gothenburg Nightclub fire, 63 killed, Sweden 1998;
- Station Night Club fire, 100 killed, USA, 2003;
- Santika Club fire, 61 killed, Bangkok, 2008
When you add these UK fires to the international experience of major fires with large loss of life, certain trends begin to emerge such as:

- Lack of awareness of fire risk by management;
- Reckless disregard for safety by management;
- Poor management of fire safety generally;
- Poor staff training and preparedness;
- Inappropriate or confused response by the public;
- Inadequate fire safety structural provision for use/risk;
- Inappropriate internal wall and ceiling linings
- Fire safety structure missing, damaged or miss-used;
- Fire equipment or installation failure;
- Inadequate means of escape, such as locked or blocked exits;
- Overcrowding.

This list is not conclusive, but it does highlight commonly recurring problems.
Protection and the Firefighter

“Fire prevention and protection activity has long played a key role in significantly reducing the incidence of fire and associated deaths and injuries, both in domestic and commercial premises. Through their role and partnership arrangements, fire and rescue authorities are ideally placed to make a wide and valuable contribution in support of a safer society.”


It is a fact that operational personnel are most likely to regularly meet the general public and encounter fire safety problems whilst undertaking their duties.

The Fire and Rescue Service (FRS) has an excellent reputation for dealing with emergency incidents. There is both a public and organisational expectation that operational Firefighters will also be capable of identifying fire safety problems and dangerous conditions. It follows that Firefighters have a responsibility to be the “eyes and ears” of the Fire and Rescue Authority (FRA) with regard to fire safety matters.

If circumstances or conditions are encountered which cause concern, then Firefighters should bring such matters to the attention of their Crew, Watch or Station Manager. Such concerns may then be forwarded to specialist Protection Officers to deal with.
Specialist Protection Officers

All Fire and Rescue Service’s (FRS) maintain a core of specialist Protection Officers who will have responsibility to lead on fire safety matters.

A specialist officer’s work might include:

- Dealing with members of the public and managers/owners with responsibility for premises, businesses and organisations;
- Fire safety inspection and audit of premises and their management;
- Giving fire safety advice, guidance and information;
- Responding to allegations of dangerous conditions (24 hours a day cover provided by the FRS);
- Enforcing fire safety law, drafting and serving statutory Notices, etc;
- Helping to bring prosecutions by gathering evidence, assembling prosecution case documents, liaising with legal professionals and presenting evidence in Court;
- Assisting with the processing of Building Regulations applications;
- Giving technical fire safety advice to major building development projects;
- Advising and checking on advanced fire engineering projects (sprinklers, smoke calculations, etc.).
To perform these specialist tasks additional training and personal development is required. Levels of responsibility will obviously vary according to the officers’ qualifications and experience.

Many FRS personnel who are promoted or transferred into Protection work find it very rewarding and discover that it greatly enhances their professional experience and competence across the board, making them a more accomplished officer.

For some personnel, fire safety becomes a career path in its own right and such individuals often achieve higher educational qualifications in fire safety subjects.
CHAPTER 3

Fire Safety Legislation
**The Development of Fire Legislation**

The preceding chapter Introduction to Protection explained the evolutionary nature of the development of fire law in the UK by reference to notable incidents.

As this history illustrates, fire safety laws developed in something of a piecemeal fashion. At one time there were over sixty different pieces of legislation that dealt with fire in some way.

Prior to the introduction of the Regulatory Reform (Fire Safety) Order 2005, there were two main pieces of fire safety legislation enforced by Fire and Rescue Authorities (FRA):

- The Fire Precautions Act 1971;
- The Fire Precautions (Workplace) Regulations 1997

This legislation provided a mix of prescriptively enforced and risk based self-compliance fire law (via a Fire Certification regime and fire risk assessments respectively). Often both pieces of legislation were simultaneously applicable to one premises!

Understandably, building occupiers and business owners were sometimes confused as to what was required of them.

Thankfully, the Secretary of State using powers conferred under the Regulatory Reform Act of 2001 resolved this confusing situation by introducing the Regulatory Reform (Fire Safety) Order in 2005. In this Handbook this legislation will often be abbreviated to FSO.

This FSO effectively swept away almost all preceding fire legislation and regulation, predominantly leaving a single fire safety regime in its place which applies almost everywhere.
It is this broad application of the FSO to a much wider range of premises than before, that forced a major re-think in the Fire and Rescue Service’s (FRS) fire safety audit and enforcement protocols. It became no longer practical to enforce fire safety law in the previous manner. Instead, FRAs had to target their resources and activities at those premises which present the greatest fire and life risk.

To help FRA’s target more effectively, the Department for Communities and Local Government produced IRMP Enforcement Guidance Note No. 4: A Risk Assessment Based Approach to Managing a Fire Safety Inspection Programme (see website address at end of handbook).
Introduction to the Regulatory Reform (Fire Safety) Order 2005

When dealing with members of the public who may have statutory fire safety responsibilities imposed upon them it is important that all references to law given to them by the Fire and Rescue Service (FRS) are accurate. At the very least, Firefighters should be able to tell such members of the public the correct title of the fire safety law applicable, even if they cannot be expected to tell them all the precise details of that law.

The fire safety regime introduced by the FSO is very similar in concept and practice to the UK’s established health and safety regime, in that:

- It places an absolute duty on the “Responsible Person” to comply. Ignorance of legal responsibilities or statutory requirements is no defence;

- All fire safety measures should be based on the findings of a “suitable and sufficient” fire risk assessment undertaken by (or on behalf of) the Responsible Person;

- Prescription is gone. The FSO itself is littered with phrases such as “where necessary”, “to the extent that is appropriate”, etc. It is up to the Responsible Person to decide what needs to be done. National guidance on how to comply is published but it is not always necessary to follow it slavishly. All fire safety measures should be risk appropriate.

In the following sections that deal with the FSO, all information has been deliberately condensed and simplified to aid understanding. This handbook will not cover every aspect of the FSO, nor will it necessarily cover it in the same order as written.
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This handbook follows the accepted legal*custom and practice of making all references to persons in the male gender. Such references should be regarded as equally applicable to the female gender.

The information provided in this handbook will be sufficient to study for most of the assessments that are undertaken during the Protection Foundation Course.

For students who wish to undertake more comprehensive and detailed study, it will be necessary to read the full text of the FSO which is available on-line (details given at the end of the handbook). To aid further study, references to individual Articles of the FSO will be given in brackets, e.g. (See Article 9).

* See the Interpretations of Statutes Act 1978, Section 6.
**The Regulatory Reform (Fire Safety) Order 2005**

Where does the FSO apply?

The FSO applies to “premises” which are defined in the Order as “any place”. In effect the FSO can apply almost everywhere and includes workplaces, vehicles, vessels, aircraft or hovercraft; any installation on land, a tent or movable structure.

It is in fact easier to define those categories of premises which are exempt:

- domestic premises;
- offshore installations;
- ships, in respect of the normal ship-board activities of a ship’s crew which are carried out solely by the crew under the direction of the master;
- fields, woods or other land forming part of an agricultural or forestry undertaking but which is not inside a building and is situated away from the undertaking’s main buildings;
- aircraft, locomotive or rolling stock, trailer or semi-trailer used as a means of transport or a vehicle for which a license is in force under the Vehicle Excise and Registration Act 1994 or a vehicle exempted from duty under that Act;
• mines (within the meaning of section 180 of the Mines and Quarries Act 1954), other than any building on the surface at a mine;

• borehole sites.

In most cases exemption from the FSO is because application would be impractical, or because there is superior national or international legislation and regulation which covers these specialist fields.

It is important to note at this point that the FSO applies to England and Wales only. Different (but very similar) legislation applies in Scotland. Northern Ireland and the Isle of Man also operate with different fire law.

(See: Article 2 – Interpretations; Article 6 - Application to premises).
Who enforces the FSO?

For the majority of premises the enforcing authority is the Fire and Rescue Authority (FRA).

However, there are some exceptions:

The Health & Safety Executive enforces the FSO in:

- Premises licensed under the Nuclear Installations Act 1965 (or premises which would normally require such a license or permit);

- Ships under construction, repair, etc. by persons other than the ships master and crew;


The Defence Fire Service enforces the FSO in:

- Crown armed forces premises;

- Visiting armed forces premises and HQs;

- Premises occupied solely for the purposes of the armed forces but not occupied by them.

The Local Authority enforces the FSO in:

- Sports grounds designated as requiring a Safety Certificate and regulated stands.
The Crown’s Fire Inspectorate enforces the FSO in:

- Crown premises (not armed forces, e.g. tax offices, Government buildings, etc.);
- Premises in relation to the United Kingdom Atomic Energy Authority.

The FRA (or other enforcing authority) must enforce the FSO. The use of the word “must” is compelling. The FRA has no choice but to enforce the FSO when it encounters non-compliance.

*(See Article 25 - Enforcing Authorities)*

*Please also read the section on Primary Authority Schemes in chapter 14.*

Who has responsibility to comply?

The FSO creates a legal entity known as the “Responsible Person”. This person can be:

- in relation to a workplace, the employer, if the workplace is to any extent under his control; or
- if not a workplace, the person who has control of the premises (as occupier or otherwise) in connection with the carrying on by him of a trade, business or other undertaking (for profit or not); or
- the owner, where the person in control of the premises does not have control in connection with the carrying on by that person of a trade, business or other undertaking.
If a person has a contractual or tenancy obligation for the maintenance, repair or safety of a premises they can be regarded a person in control of the premises and therefore acquire responsibility relating to the extent of their control.

It has to be understood that the Responsible Person has an absolute duty to comply with the FSO. The Responsible Person has to “get on with it” without waiting for a prompt or direction from the enforcing authority. If assistance is sought from another person to help with their fire safety arrangements, the Responsible Person has a duty to ensure they are competent to undertake such tasks and responsibilities. Just as in health and safety legislation, ignorance will be no defence for non-compliance.

In addition to the duties imposed on Responsible Persons, there are duties imposed on employees. An employee at work must:

- Take care of himself and other relevant persons who may be affected by his acts or omissions;

- Co-operate with his employers efforts to comply with the FSO;

- Inform his employer of any work situation or matter which could present serious or imminent danger, or reveal shortcomings in the employer’s safety arrangements.

(See Article 3 – Meaning of "Responsible Person"; Article 5 - Duties under this Order; Article 23 – General duties of employees at work)
What Has To Be Done?

The Responsible Person’s main fire safety responsibilities include:

- Risk Assessment
- Fire & Emergency Planning
- Means of Escape
- Procedures for serious and imminent danger
- Co-operation & Co-ordination
- Principles of Prevention
- Fire Detection
- Fire Fighting
- Maintenance
- Staff Instruction
- Mitigating effects

This handbook will explore a few of the relevant articles of the FSO in more detail.
Fire Risk Assessment

No particular system or method of fire risk assessment is mandatory, although the Government has produced some guidance which could be adopted. Instead the FSO concentrates on achieving satisfactory outcomes. The objective is to identify and evaluate all fire risks to which “relevant people” are exposed and create a “suitable and sufficient” fire risk assessment which will enable those risks to be tackled.

Relevant people are those legally allowed on the premises, e.g. staff, visitors, customers, contractors, etc.

People who are not legally allowed on the premises (burglars, etc.) and firefighters engaged in emergency incidents at the premises, are not deemed to be relevant people.

The overall aim of a fire risk assessment is to reduce the risk of fire and fire spread and ensure that people can escape safely.

The FSO also requires the fire risk assessment to be reviewed whenever there is reason to suspect that it is no longer valid, or if significant changes to the matters to which it relates are proposed.

The presence of “dangerous substances” must be taken into account. Dangerous substances are defined in the FSO as substances which are classified as:

- explosive, oxidising, extremely flammable, highly flammable or flammable;
- a substance or preparation which because of its physico-chemical or chemical properties and the way it is used or is present in or on premises creates a risk; and
• any dust, whether in the form of solid particles or fibrous materials or otherwise, which can form an explosive mixture with air or an explosive atmosphere.

The FSO includes dangerous substances so that their impact and influence can be taken into account to determine the general fire precautions that may have to be adopted. The FRA does not enforce health and safety legislation and regulation governing storage, manufacturing or “work process” risks associated with dangerous substances.

The presence of young people (under 18) must also be taken into account in the fire risk assessment. As young people are unlikely to be so aware of fire hazards and risks the assessment may have to include special measures to counteract this. The significant findings of the fire risk assessment must be forwarded to the young person’s parent or guardian so that they can make an informed decision about the risks to which the young person is exposed.

The Responsible Person must* also appoint one or more competent persons to assist him undertake the preventive and protective measures and general fire precautions identified as required in the fire risk assessment.

The topic of fire risk assessment, the principles of prevention and managing fire risk will be dealt with in more detail elsewhere in this handbook.

*This "must" will not apply if:

• an individual is self-employed; or
• employers working in partnership;
and who has/have sufficient training, experience or knowledge to undertake the preventive and protective measures themselves.
(See: Article 2 Interpretation – Dangerous substances & Relevant persons; Article 9 – Risk assessment; Article 12 – Elimination or reduction of risk from dangerous substances; Article 19 – Provision of information for employees; Article 18 – Safety assistance; Schedule 1, Part 1 – Matters to be considered in risk assessment in respect of dangerous substances)
Principles of prevention

When conducting a fire risk assessment and attempting to determine what must be done, the FSO directs the Responsible Person to apply the principles of prevention, which are:

- Avoiding the risk;
- Evaluating the risks which cannot be avoided;
- Combating the risk at source;
- Adapting to technical progress;
- Replacing the dangerous with the non-dangerous, or less dangerous;
- Developing a coherent overall prevention policy;
- Giving collective prevention measures priority over individual prevention measures;
- Giving appropriate instruction to employees.

These principles provide a hierarchy of measures to be adopted to eliminate, or reduce risk down to acceptable levels. They provide a benchmark against which a Responsible Person’s fire risk assessment and the resultant actions taken can be measured.

(See: Article 10 – Principles of prevention to be applied; and Schedule 1, Part 3 – Principles of prevention)
Fire and emergency planning

The Responsible Person must Plan, Organise, Control, Monitor and Review (POCMaR) all his fire safety arrangements, which will include:

- Acting on the findings of his fire risk assessment to reduce the risk of fire and fire spread;
- Provide adequate means of escape from fire and ensuring that it can be used*;
- Fighting fires*;
- Detecting and giving warning of fire*;
- Action to be taken in the event of fire*;
- Staff fire training and instructions*;
- Mitigating the effects of fire*.

* Collectively these requirements are referred to as General Fire Precautions.

This requirement is primarily focused on how people manage their fire risk. Depending on the size of the business or undertaking there is an expectation that the management will be able to produce evidence of POCMaR. Where five or more people are employed, or where a license or Alterations Notice (see page 67) is in force, a record of POCMaR must be kept.
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Such evidence could include fire policies, defined fire safety roles and responsibilities for managers and employees, fire risk assessments, records of control and monitoring arrangements, fire routines and procedures, records of staff training and fire drills, records of maintenance and testing, structure charts, etc.

As a failure of management is so often a key aspect of real fire incidents, a Responsible Person, and particularly an employer, may find themselves held to account in a court of law for failure to demonstrate that they have adequately put into effect their POCMaR arrangements.

(See: Article 11 – Fire safety arrangements; Article 15 – Procedures for serious and imminent danger and for danger areas.)
Fire fighting

To safeguard the safety of relevant people the Responsible Person must, where necessary, ensure that his premises are equipped with appropriate fire-fighting equipment.

To determine what is appropriate, the size and use of the premises, equipment and substances likely to be present, activities carried out, hazard present, etc. must be taken into account. This is best achieved during the fire risk assessment process.

The FSO does not prescribe what firefighting equipment to have, or how it should be distributed around the premises. When making such decisions it is common good practice to follow the recommendations and guidance in British Standards (i.e. BS 5306. Part 8).

Having decided what fire-fighting equipment is needed the Responsible Person must, where necessary, take measures for fire-fighting, nominate competent persons to implement those measures, and arrange any necessary contacts with the emergency services.

Fire detection and warning

To safeguard the safety of relevant people the Responsible Person must, where necessary, ensure that his premises are equipped with appropriate fire detectors and alarms.
To determine what is appropriate, the size and use of the premises, equipment and substances likely to be present, activities carried out, hazard present, maximum numbers of people present, etc. must be taken into account.

The FSO does not prescribe what fire detection or alarm to have. This is best determined during the fire risk assessment process. When making such decisions it is common good practice to follow the recommendations and guidance in British Standards (i.e. BS 5839. Part 1). Alternatively, if this standard is not easily accessible, some fire alarm manufacturers provide their own free technical guides based on the standard, either in booklet form, or on-line.

*(See Article 13– Fire-fighting and fire detection)*
Means of escape from fire

Where necessary, fire exits and routes to fire exits must be kept clear at all times.

The FSO sets out a number of other requirements relating to means of escape, and at first reading they can appear to be prescriptive:

- Emergency routes and exits must lead as directly as possible to a place of safety;
- In the event of danger it must be possible for persons to evacuate as quickly and safely as possible;
- The number and distribution of fire exits must be adequate for the premises and the number of persons who may be present at any time;
- Emergency doors must open in the direction of escape;
- Sliding or revolving doors must not be used for emergency exits;
- Emergency doors must not be locked or fastened so that they cannot be easily and immediately opened by any person required to use them in an emergency;
- Emergency routes must be indicated by signs;
- Emergency routes and exits requiring illumination must be provided with emergency lighting.

However, in the full text of the FSO these requirements are pre-cursed by the phrase “where necessary”.

It is the fire risk assessment based on sound fire safety guidance which will determine what requirements must be complied with, and to what extent.

Means of escape from fire is a complex subject and it will be dealt with in more detail elsewhere in this handbook.

*(See Article 14 – Emergency routes and exits)*)
Procedures for serious and imminent danger and danger areas.

Arrangements for planning for a fire emergency or any situation which presents serious and imminent danger, should include appropriate procedures and safety drills and the nomination of a sufficient number of competent persons to implement evacuation procedures.

No relevant persons should be able to access any safety restricted area unless they have received adequate safety instruction.

As far as practical, relevant persons who are exposed to serious and imminent danger should be informed of the hazard and the steps to be taken to protect themselves from it.

Relevant persons should be able to stop work and immediately proceed to a place of safety in the event of being exposed to serious, imminent and unavoidable danger, and unless there are exceptional reasons, the person should be prevented from resuming work if there is still a serious and imminent danger.

The FSO also covers emergency measures for premises which have dangerous substances in or on them. These include:

- Providing information on emergency arrangements, work hazards and hazard identification, and specific hazards that may arise at the time of any accident, incident or emergency;

- Establishing warning and communication systems to enable an appropriate response to an accident, incident or emergency;

- Provide audible or visual warnings before any explosion condition is reached to enable people to withdraw;
• Where necessary provide and maintain escape facilities so that people can leave endangered places promptly and safely.

Information about all the above arrangements must be made available to relevant accident and emergency services to enable them to prepare their own response procedures. The information should be displayed on the premises, unless the fire risk assessment concludes that this is unnecessary.

(See: Article 15 – Procedures for serious and imminent danger and for danger areas; Article 16 – Additional emergency measures in respect of dangerous substances)
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Maintenance

To safeguard the safety of relevant persons any facilities, equipment or devices provided in connection with general fire precautions must (where necessary) be subject to a suitable system of maintenance, maintained in an efficient state, in efficient working order and in good repair.

Many premises have facilities and equipment built-in or installed to help firefighters in their work. As firefighters responding to an emergency incident in premises are not deemed to be “relevant people” the FSO also introduces a requirement to maintain such facilities and equipment.

To safeguard the safety of fire-fighters any facilities, equipment or devices provided in the premises for the use or protection of fire-fighters must be subject to a suitable system of maintenance, maintained in an efficient state, in efficient working order and in good repair.

Where a building is divided into multiple occupancies the FSO requires all occupiers (or owners) to co-operate, even if the FSO does not apply to some parts of the building.

For all maintenance issues the FSO does not prescribe what maintenance regime must be adhered to but it is common good practice that such systems as fire alarms, escape lighting, fire-fighting equipment, firefighters lifts, dry risers, etc. should be maintained in accordance with the relevant British Standards. The official guidance published by the Government supports this approach.
(See: Article 17 – Maintenance; Article 38 – Maintenance of measures provided for protection of fire-fighters)
Staff instruction and training

Employees - The FSO requires Responsible Persons to provide his employees with the following information:

- The relevant risks identified in the fire risk assessment;
- What fire precaution measures and arrangements have been adopted;
- What fire procedures and evacuation drills have been adopted;
- Who has been nominated for first-aid firefighting and to assist with any fire evacuation (Fire Marshalls, etc.);
- If in a multi-occupied building, any relevant risks identified in other’s fire risk assessments.

The information may need to be supplied in other languages, if the employee’s first language is not English.

If children or young people (under 18) are employed similar information must be conveyed to the parent* of that person.

If dangerous substances are present in the premises then additional facilities and information must be provided:

- The name of any dangerous substances and the risks they present;
- Access to any relevant safety data sheet, and related legislative provisions which apply;
- The significant findings of the fire risk assessment.

* As defined in the Children Act 1989.
Non-Employees - Many businesses and premises have non-employees such as contractors, agency staff, etc. working on site. The FSO requires the Responsible Person to relay to their employer:

- The risks to their employees, and;
- What fire precaution measures and arrangements have been adopted;
- How to identify persons nominated to assist with any fire or emergency evacuation (Fire Marshalls, etc.).

The FSO also requires that non-employee persons (such as the self-employed) are provided with similar appropriate instructions and information regarding any risks to that person and how to identify persons nominated to assist with any fire emergency or evacuation.

All information provided to employees, employers and the self-employed must be relevant and comprehensible. No particular format or method of relaying such information is prescribed, instead the FSO focuses on ensuring the information is provided in an understandable way for the receiving person.

Depending on the needs of employers, employees and non-employees, it could be in any language or format that works for those persons.
Staff Training – Employees (which may include volunteers) must be provided with adequate training:

- When first employed;
- When exposed to new or increased risk (such as when transferred, change to responsibilities, new work processes or equipment, etc.).

The instruction and training must be suitable and sufficient so that the employee knows what precautions and action he must take to safeguard himself and other relevant persons on the premises.

This training must:

- be repeated periodically;
- must take into account new or changed risks;
- be provided in a manner appropriate to the risk identified in the fire risk assessment; and
- be provided during working hours.

*(See: Article 19 – Provision of information to employees; Article 20 – Provision of information to employers and the self-employed from outside undertakings; Article 21 - Training)*
Co-operation and co-ordination

Many buildings are multi-occupied, that is occupancy is shared between two or more individuals, businesses or organisations.

In such circumstances it can sometimes be difficult to get clear-cut agreement and division of responsibility between occupiers as to what needs to be done to keep the building and its people safe, and who is going to do it.

The FSO requires that where two or more Responsible Persons share, or have duties in respect of premises, each person must co-operate with the other Responsible Person and take steps to co-ordinate the measures taken to comply with the FSO. They must also inform each other of any risks to relevant persons from their occupancy.

(See Article 22 – Co-operation and co-ordination)
Mitigating the effect of fire

The requirement to mitigate (make less serious or severe) the effect of fire is included within the meaning of “general fire precautions” given in the FSO. The FSO does not provide any further information on this topic.

However, a study of other documents, such as the Government’s: consultation prior to the introduction of the FSO; published fire risk assessment guides; and Enforcement Guidance Note No. 1, seem to indicate that mitigating the effects of fire will involve preventing or reducing the likelihood of fire arising, or to reduce its intensity and detrimental impact should one occur.

Practical steps to mitigate the effects of fire could include:

- Conducting a suitable and sufficient fire risk assessment and applying the principles of prevention;
- Reducing or removing any unnecessary quantities of storage of combustible stock and materials;
- Storing combustible stock or materials in such a way that fire is less likely to spread from one batch to another;
- Installing fire-fighting equipment or fire sprinklers;
- Preparing a fire salvage plan to determine a priority list of what should be protected or removed from the premises on fire (if possible);
- Preparing a fire recovery plan to:
  - Organise premises key holders;
• Allocate fire recovery tasks and responsibilities to individuals;

• Have essential information readily available such as: out of hour’s contacts, employee, insurer, contractors and customer contacts, etc.

• Identify in advance any potential alternative accommodation or facilities that could be used, etc.

• Regularly backing-up important data and information in a safe facility.

It is difficult to arrive at a conclusive list as every circumstance will be different. The overall aim should be to plan what would need to be done to reduce the size and impact of any fire, and how to best deal with the disruption that fire brings.

It should also be noted that the FRAs enforcement of the FSO is constrained to general fire safety matters only. Regulations and issues relating to storage and process risks (especially those involving dangerous substances) will be dealt with by the Health and Safety Executive.

(See Article 4 – Meaning of "general fire precautions")
Ensuring Compliance

Powers of inspectors

To assist with enforcement the FRA has the ability to appoint inspectors. Such inspectors are given certain powers, such as:

- To enter any premises which he has reason to believe it is necessary for him to enter to enforce the FSO, at any reasonable time;

- To make enquiries to ascertain whether the provisions of the FSO have been complied with and identify the Responsible Person;

- To require the production of any records which are required to be kept by virtue of the FSO so that he can inspect them, and if necessary take copies;

- Require any person with responsibilities in relation to any premises to give him such facilities and assistance as to enable the inspector to exercise his powers;

- To take samples of any article or substance found in any premises to ascertain their fire resistance or flammability;

- If articles or substances are found which appear to have caused, or are likely to cause danger to the safety of relevant persons, to cause it to be dismantled or subjected to any process or test.

Note that the use of the word “power” in the FSO indicates that the power may, or may not be exercised at the discretion of the person having that power. Therefore, whilst the FRA “must” enforce the FSO it does not necessarily have to send officers out to inspect and find problems!
A key point to note is that unless a person has been appointed as an inspector by his or her Fire and Rescue Authority, they are not entitled to exercise these powers. Inspectors should carry and produce if required evidence of their authority to exercise their powers under the FSO.

A statutory code of practice for the exercise of powers of entry was introduced in 2014. Please see chapter 14 for further information.

Caution – Fire Safety Checks are intended to be relatively brief visits to premises, simple to conduct and their underpinning philosophy should be business friendly and helpful. The full range of powers set out in this section are not usually available to operational personnel (e.g. taking samples, testing, etc.).

When attempting to conduct a fire safety check, it is not expected that operational personnel will have to exercise these powers in a formal or officious way. If difficulties are encountered with gaining access or assistance, personnel should refer the matter to their line manager or a specialist Protection Officer who will be best placed to deal with such matters.

(See Article 27 – Powers of inspectors)
Alterations Notices

In any FRA territory there will be a mix of different premises and risks. Some of these premises will be, or have the potential to be, higher fire risk. This may be because of the nature of the premises and its use, or because the premises management has a history of poor compliance with the FSO.

The Alterations Notice is a tool that can be used by the FRA to proactively control or influence the management of fire risk within such high risk premises.

If the FRA is of the opinion that a premises constitutes a serious fire risk to relevant persons, or that it may constitute such a risk if any changes are made, it can serve an Alterations Notice on the Responsible Person, giving the reasons why.

The effect of such a notice is to require the Responsible Person to notify the FRA of any proposed changes to the premises before proceeding.

The terms of the notice may vary, but could include requirements to send the FRA copies of their fire risk assessment and details of their fire safety arrangements.

*(See Article 29 – Alterations notices)*
Enforcement Notices

When there are significant failures to comply with the requirements of the FSO in a premises, the FRA has the power to issue an Enforcement Notice on the Responsible Person, or person in control of the premises.

It is good practice that consultation takes place between the FRA’s inspecting officers and the intended recipient so that the most practical and efficient Notice can be drafted. This is especially important as the person upon whom the Enforcement Notice is served can appeal against the Notice. Any appeal will suspend the Notice until such time as the Court decided whether to uphold it, change it, or cancel it.

The Enforcement Notice:

- Will state the reasons why the Notice has been issued;
- Will specify which provisions of the FSO have not been complied with;
- Will require that person to take steps to remedy the situation within a given time period;
- May include directions as to how to remedy such failures, giving choices and options between different ways to remedy the contraventions.

Recognising that there are other enforcing authorities of other legislation and regulation who may have an interest in the premises, the FSO requires the FRA to try to consult with such authorities before issuing any Enforcement Notice. The aim of this requirement is to try to avoid any conflict of interests and requirements between authorities.
It is hoped that this consultation period will stop the Responsible Person receiving conflicting, multiple or duplicate requirements from different enforcing authorities.

*(See Article 30 – Enforcement Notices)*

**Prohibition Notices**

Prohibition Notices are reserved for those circumstances where the risk to relevant persons is so severe that the use of the premises must be restricted or stopped immediately.

Such situations are often referred to as “dangerous conditions”. It is impossible to list all the different types or combinations of dangerous conditions that can be encountered, but they will all have one thing in common, namely that if the premises are used then people’s lives are, or will be at high risk.

Examples of situations and circumstances that could give rise to dangerous conditions include:

- Premises totally unsuitable for the use to which it is being put;
- Overcrowding of a premises so that means of escape is compromised or ineffective;
- Blocked, obstructed, restricted or complex escape routes;
- Blocked, obstructed or locked fire exits;
- Missing or defective fire alarm and/or detection system;
• Excessive travel distances;

• Missing or defective structural fire resistance;

• Excessively high risk of fire breaking out or spreading.

This list is by no means conclusive.

The Prohibition Notice:

• Will state the FRA’s opinion that the use of all or part of the premises should be prohibited or restricted;

• Will specify the reasons why;

• Direct that the use to which the Notice relates is prohibited or restricted as specified in the Notice;

• May include directions as to the measures that will have to be taken to remedy the situation, giving alternative options and choice as appropriate;

A Prohibition Notice takes effect immediately it is served. Appeal against the Notice can be made, but the Notice continues in effect whilst any appeal process takes place. All Fire and Rescue Services have procedures in place for the reporting of, and reaction to, dangerous fire safety conditions. You are encouraged to study these so that you can play your part in implementing them.

It must be emphasised that Firefighters are the “eyes and ears” of the FRA and are frequently best placed to identify and report dangerous conditions.

(See Article 31 – Prohibition Notices)
Offences

Not every breach of the Order automatically constitutes an offence. Depending on circumstances and certain legal technicalities and protocols, a failure to comply with the FSO is a criminal offence, and therefore dealt with in the criminal courts. Many of the offences are “either way” offences, that is they can be dealt with summarily in the Magistrates Court, or can be heard (or sentenced) in the Crown Court.

The principle and probably most common offences are a failure to comply with the main requirements of the FSO as discussed previously in this handbook, namely:

- Duty to take general fire precautions;
- Fire risk assessment;
- Principles of prevention;
- Fire safety arrangements;
- Elimination or reduction of risk from dangerous substances;
- Fire-fighting and fire detection;
- Emergency routes and exits;
- Procedures for serious and imminent danger;
- Maintenance;
- Safety assistance;
- Provision of information for employees;
- Provision of information to employers and the self-employed;
- Training;
- Co-operation and co-ordination.

In all the above cases it is necessary to establish that the failure has caused relevant persons to be at risk of death or serious injury in case of fire. If this cannot be proved to the Courts satisfaction then no offence has been committed.
Other “either way” offences include:

- Failure to comply with an Alterations Notice;
- Failure to comply with an Enforcement Notice;
- Failure to comply with a Prohibition Notice;

A Magistrate can impose a fine of any amount for each offence.

A Crown Court can impose a fine, and/or imprisonment for a term not exceeding two years for each offence.

Other offences are only dealt with summarily in the Magistrates Court and will attract lesser sentences. These include:

- Intentionally obstructing an inspector exercising his powers;
- Failure to comply with general duties of employees at work and placing one or more relevant persons at risk of death or serious injury in case of fire;
- Giving false information or making false records or entries into books, notices or documents;
- Pretend, with intent to deceive, to be an inspector,
- Etc.

As can be seen this list is not conclusive.

*(See Article 32 – Offences)*
Defences

A person’s defence will rest on only two foundations:

- To prove that the offences in question have not been committed; or

- To prove that he took all reasonable precautions and exercised all due diligence to avoid the commission of such an offence (usually referred to as the “due diligence defence”).

It must be noted that the “due diligence” defence is not available to employers for offences committed by employees or safety assistants. This is because there is an expectation that an employer should have monitored, controlled or supervised their activities (POCMaR). It stops an employer trying to point the blame at a “Scape-goat”.

*(See Article 33 - Defence)*
CHAPTER 4

Technical Guidance and Reference
Fire Safety Guidance

The Government* has produced a number of guidance documents to help Responsible Persons find out what needs to be done to comply with the FSO.

Each guide is targeted at a different type or category of premises and they should provide relevant fire risk assessment and management information for that risk group.

The guides can be purchased in hard-copy format (currently £12) or can be viewed and downloaded free of charge from the DCLG website.

They are “guides”, which means that they do not have to be followed prescriptively. When conducting a fire risk assessment and trying to determine what could or should be done, the Responsible Person can exercise some flexibility and may even find alternative methods to achieve appropriate levels of safety.

However, it should also be borne in mind that this suite of guidance documents does provide an official benchmark against which premises can be compared, and the guidance offered can influence the decisions of the Courts when hearing fire safety indictments and appeals.

The full list of available guides is provided on the next page.

* England & Wales only
| **Offices & Shops** – Offices and retail premises (including individual units within larger premises, e.g. shopping centres). |
| **Factories & Warehouses** – Factories and warehouse storage premises. |
| **Sleeping Accommodation** – All premises where the main use is to provide sleeping accommodation, e.g. Hotels, guest houses, B & B, hostels, residential training centres, holiday accommodation, common areas of flats, maisonettes, HMOs and sheltered housing (other than those providing care – see Residential care premises), but excluding hospitals, residential care premises, places of custody and single private dwellings. |
| **Residential Care Premises** - Residential care and nursing homes, common areas of sheltered housing (where care is provided) and similar premises, which are permanently staffed and where the primary use is the provision of care rather than healthcare (see Healthcare premises). |
| **Educational premises** - Teaching establishments ranging from pre-school through to universities, except the residential parts (see Sleeping accommodation). |
| **Small and medium places of assembly** - Smaller public houses, clubs, restaurants and cafés, village halls, community centres, libraries, marquees, churches and other places of worship or study accommodating up to 300 people. |
| **Large places of assembly** - Larger premises where more than 300 people could gather, e.g. shopping centres (not the individual shops), large nightclubs and pubs, exhibition and conference centres, sports stadia, marquees, museums, libraries, churches, cathedrals and other places of worship or study. |
| **Theatres, cinemas and similar premises** - Theatres, cinemas, concert halls and similar premises used primarily for this purpose. |
| **Open air events and venues** - Open air events, e.g. theme parks, zoos, music concerts, sporting events (not stadia – see Large places of assembly), fairgrounds and county fairs. |
| **Healthcare premises** - Premises where the primary use is the provision of healthcare (including private), e.g. hospitals, doctors’ surgeries, dentists and other similar healthcare premises. |
| **Transport premises and facilities** - Transportation terminals and interchanges, e.g. airports, railway stations (including sub-surface), transport tunnels, ports, bus and coach stations and similar premises but excluding the means of transport (e.g. trains, buses, planes and ships). |
| **Stables and agricultural premises** - Agricultural premises, stables, livery yards and stables within zoos, large animal sanctuaries or farm parks. |
| **Means of Escape for Disabled People** - This guide is a supplement to be read alongside other guides in this series. It provides additional information on accessibility and means of escape. |
CHAPTER 5

Means of Escape from Fire
Introduction to Means of Escape

In the UK it is a legal requirement that buildings and premises have adequate means of escape from fire for all occupants.

Firefighters will enter buildings and premises both in their private and professional lives and may encounter fire safety conditions which are inadequate or even dangerous. It is therefore important that Firefighters understand the basic principles of means of escape from fire so that they can recognise such failings and feel empowered to report them appropriately.

Methods for ensuring adequate means of escape from premises in the event of fire have many different aspects. It is a convention that these aspects are broken down into six main topic areas, namely: Management, Occupancy, Construction, Time, Exits, Travel distance (MOCTET). This lesson has been prepared to provide basic underpinning knowledge and understanding of the factors that contribute to effective means of escape.
Means of Escape

Fires within buildings and premises are un-planned events. Fires could start at any time of day, in almost any location and regardless of how many people are in the building.

To ensure that all people can leave the building quickly and safely, buildings and premises need to have means of escape designed-in, maintained and well managed.

Escape routes may be part of the normal way in and way out of the premises (usually best practice). On occasions they may be dedicated solely as fire escape routes.

The physical aspects of means of escape are sometimes defined as:

*Structural means forming an integral part of the building whereby persons can escape from fire by their own un-aided efforts, to a place of safety.*

“Structural & integral” - Meaning part of the building, not readily removable, built in, e.g. internal staircases, external fire escapes, fire walls, corridors, exit doors etc.

Means of escape staircase in residential hi-rise block.

Escape staircases do not have to be so plain and utilitarian in their design.
“Un-aided efforts” – As far as practically possible, means of escape has to be provided in such a way that people can evacuate without assistance. There are exceptions to this general rule, such as very young people, the elderly, people with infirmities, disabilities, or those held in secure units such as prisons, etc.

Whilst some countries will accept throw-out ladders, climb-down fluffy ropes, escape chutes, etc. the UK does not endorse the use of such devices or products because there is evidence that not all people will be willing or able to use them.

Normally, conventional lifts are excluded on the grounds of known past performance in real fire situations, i.e. people becoming trapped in them, overcome by smoke or worst still, the heat from the fire affecting the controls and summoning the lift car to the fire floor, opening the doors to let in smoke and fire. However, there is the possibility of using lifts for escape providing certain conditions, design and installation requirements are met.

“Place of safety” – this is a place clear of, and away from the building so that persons are no longer under threat from the developing fire, smoke, or falling debris.
A simple alternative to this MOE technical definition could be that people should be able to turn their back on the fire, walk away, get out of the building, catch a bus and go home!

This simplistic concept of means of escape is not always practical and achievable for all types of premises. For example, blocks of flats, prisons, hospitals, old person’s homes, etc., require a different approach. Escape from such premises will be discussed later in this handbook.

Certain questions must be answered before any decision can be made as to what means of escape (MOE) scheme is appropriate for any building. These include:

1. Who is in the building?
2. Where are they in the building?
3. What are they doing in the building?
4. What is the building made of?
5. How quickly do we need them to be able to get out?
6. How far can they walk in the time available?
7. How do we get them out?
8. How is the scheme to be managed?
For convenience, such questions and their underpinning considerations are summarised into a mnemonic MOCTET which stand for:

Management

Occupancy

Construction

Time of evacuation

Exits

Travel distances

This handbook will explore each of these aspects in turn (but not necessarily in the same order).

Urban Myth or Fact? - The Toilet Snorkel

Designed to allow a person trapped by fire to breath smoke-free sewer air. This allegedly patented invention is not accepted as a life saving device in the UK.
Management

Management is arguably the most important aspect of MOE from buildings, because unless management undertakes its fire safety responsibilities efficiently and effectively, even the best designed and equipped buildings can quickly deteriorate and become dangerous in the event of fire.

In almost all real fire case histories, failure of management to recognise or properly deal with fire risk, or to plan for a fire emergency, can be identified as major contributory factors. It is estimated that approximately 80% of businesses never recover from a significant fire (source: Arson Prevention Bureau).

You will have seen previously the extent of management responsibilities (see Chapter 3). This part of the handbook will concentrate on the topics of Planning, Organising, Controlling, Monitoring and Review (POCMaR)*.

Obviously, how far a business or organisation has to go in achieving appropriate levels of POCMaR will depend on the nature of the risk and the size of the undertaking. High risk, large or complex undertakings will require high levels of management, etc.

Planning – the possibility and potential for a fire to occur must never be ignored. A business or organisation might have a fire policy and plan in a similar way that many organisations have a health and safety policy and plan.

* From Article 11 of the Regulatory Reform (Fire Safety) Order 2005
Good management will have plans to:

- prevent fire;
- respond to an outbreak of fire or an emergency, and;
- mitigate the effects of a fire.

All staff should be made aware of the fire plan, and in particular their own role and responsibilities towards it.

**Organising** – Having a fire policy and plan is no use unless management organises itself to implement the plan. This suggests that a business or organisation will create a structure or hierarchy of personnel with different roles and responsibilities for fire safety.

Organising can also include obtaining assistance or services from others, such as fire consultants, servicing and maintenance contractors, training providers, etc.

**Controlling** – Good management needs to be able to demonstrate that it is in control of its fire safety arrangements. Letting personnel “just get on with it” is no longer an option.

Setting clear and timely supervising and reporting procedures to ensure that nominated personnel are actually carrying out their fire safety responsibilities will contribute to this control.

This is particularly important for employers, as they no longer have any protection in law for employees who fail to follow their instructions and policies, and which results in a breach of the Regulatory Reform (Fire Safety) Order 2005.
**Monitoring** – Good management needs to be able to demonstrate that it is monitoring the success or shortcomings of its POCMaR arrangements. The keeping of records of fire planning meetings, fire risk assessments, incidents, false alarms, staff training, maintenance of fire alarms, extinguishers, etc. will provide useful information to monitor trends and performance.

**Review** – Good management should be keeping their POCMaR arrangements under review to ensure that they remain fit for purpose. This is especially important where a business or organisation operates in a particularly dynamic environment and has rapidly changing circumstances or situations to deal with.

Rather like fire risk assessment, reviews need to be undertaken whenever there is reason to believe that it may be necessary, and at least an annual periodic review date should be set as a back-stop.

Some businesses and organisations have incorporated fire safety as a standard agenda item on routine health and safety, management or staff meetings so that performance can be monitored and issues identified on a regular basis.

**Management Summary**

Fire is a very real and tangible threat. Whatever POCMaR arrangements a business or organisation creates, the main focus should be on achieving practical outcomes to avoid, or counter this threat, rather than being an exercise in bureaucracy.
**Occupancy**

Occupancy considerations include how the building or premises is used and how it is populated.

**Use of the building**

The use of some buildings can present inherently high fire hazard, high fire risk, or even both.

The presence of hazardous processes, use of heat and ignition sources, high fire loading, the presence of dangerous, flammable or explosive materials, substances and atmospheres will inevitably increase risk and therefore require additional and sometimes exceptional control measures to reduce the risk down to acceptable levels. Means of escape should be provided accordingly. The higher the risk, the greater the means of escape capacity and ease of use.

Other buildings can be classified as normal fire risk, and on rare occasions, low risk. They too should have their means of escape designed accordingly.

Placing a high fire risk occupier into a building designed for low or normal fire risk without making changes to the means of escape provision can be dangerous.

On occasions, the use of a building has been changed unofficially, for example where a “rave” party for hundreds of young people is temporarily set up in a property totally unsuitable for the purpose (terraced house, disused factory, warehouse, etc.). The means of escape for such premises were never designed to cope with this use, or numbers of people.
A means of escape scheme designed for one type of occupancy or use may not be suitable for another. It may even be highly dangerous.

**People**

Various factors contribute to the assessment of risk in relation to people within a building or premises:

1. How many people are there?
2. Where are people distributed around the building?
3. What is their age, physical or mental condition?
4. What are they engaged in doing, and is there a sleeping risk?
5. How quickly are people likely to react to a fire emergency?
6. How disciplined will people be in response to a fire emergency?

**How many people are there?**

The number and width of fire escape routes and exits should be designed to meet the needs of the number of people who are likely to use them. Architects and fire safety specialists can use data and formula given in various fire safety codes of practice and guidance documents to calculate approximate numbers of people likely to resort to a particular space or building.

Numbers of people can also be obtained by simply counting. For example; for a restaurant with 20 tables, each capable of seating four persons, it is reasonable to assume that the dining area will have a maximum population of about 80 to 90 persons (including staff).
In existing buildings where the structural means of escape might not be quite right, the total number of persons can be controlled or restricted to meet the means of escape capacity.

As a general rule of thumb, more people means that escape routes should have greater capacity and be easier to use.

Where are people distributed around the building?

People present in high numbers and concentrations present particular problems when it comes to emergency evacuation. Larger masses of people behave differently to smaller groups. Unless carefully designed, escape routes for large numbers of people will not encourage good movement speeds and any restrictions or distractions along the route can cause crushing or even total blockage.

People evacuating from a building will often feel safer when they have moved away from the perceived danger or when they emerge outside. Movement often slows down or even stops within a few metres from the final exit. This can unintentionally hamper escape for those people still inside who are trying to move quickly. Appointing fire evacuation marshals to direct people away to designated assembly points will help alleviate this problem.

Upper floors place people at higher risk from fire as the potential for fire outbreak below them is increased along with the fire loading. In addition they are at a distinct disadvantage when it comes to running away!
Risks are minimised by controlling the type of primary and secondary construction used, providing comparative safety via well-protected escape routes and incorporating passive/active fire precaution measures. Using such techniques allows high rise buildings to be constructed and safely used. Without it they would be death traps.

People who have emotional ties to others, but who are separated in a building (such as parents and their children, husbands and wives, etc.), will nearly always attempt to locate each other first rather than immediately begin their own escape.

In many fires this behaviour has led to the loss of life. In addition, their desperate attempts to find each other can hamper the escape of others (going against the flow) or the work of Firefighters. It is for this reason crèches and childcare facilities in shopping malls and offices will always be found on the ground floor and near exits.

Physical condition

The physical condition of the occupants of buildings can have a significant impact on their ability to escape from fire.

Some of the typical physical conditions that may be encountered are outlined below:

Physical Disabilities - People with mobility problems, i.e. wheelchair users, missing limbs, users of artificial limbs, either partial, or full sight and/or hearing impairment, etc.

Learning Disability – this term is used to describe a wide range of conditions. Approximately 1.5m people in the UK have some degree of learning disability.
People with a learning disability may have other physical and emotional conditions associated with their learning disability (e.g. cerebral palsy, epilepsy, autism, Asperger’s syndrome, etc.). People with learning disabilities and associated conditions may have special needs with regard to ensuring their means of escape.

Psychiatric Conditions – Some occupants of buildings may be suffering from some form of recognised psychiatric condition, such as schizophrenia, obsessive compulsive disorder, etc. People may suffer from anxiety disorders or phobias such as acrophobia (fear of heights), arsonphobia (fear of fire). Depending on the severity of the condition people may not react in normally predictable ways in any fire emergency.

Illness – Everyone is capable of suffering with some form of illness or medical condition. It may be temporary (e.g. a broken leg) or may be permanent (e.g. Heart disease, circulatory and respiratory problems, joint problems etc.).

Age -  The very young and the elderly are statistically proven to be more vulnerable groups in fire situations. Pregnant Mothers are also more vulnerable.

What are people doing?

People may be engaged in a wide range of activities (e.g. at work, study, recreation, socialising, visiting tourists, etc.). In all cases, the means of escape provision should be adequate and take into account the various factors that will change the risk profile, such as:

Intoxication – People who have imbibed alcohol, or taken drugs (legitimately or illegally), or other similar substances are at higher risk in a fire emergency. Reactions and behaviour are likely to be very different from people who have not taken such substances.
Asleep or Awake - People asleep are vulnerable and not so quick to respond to a fire emergency. In a hotel it is very likely that people will be unfamiliar with the building layout too.

Language differences may also impact on a person’s reaction to an emergency situation, or their escape behaviour. Incidents have occurred where people have not reacted to a voice fire alarm or other instructions because they did not understand the messages.

Cultural norms may also influence a person’s acceptance of risk or relationships with authority figures. Some people are used to working in countries where there are lower standards of fire safety and little or no enforcement of those standards, or where it is perceived that any engagement with a uniformed person could lead to trouble.

To summarise, the greater the number of people who use a building, the more likely it is that people with varied and different needs are going to be present. Whatever a person’s condition, there is a potential for the less-able to hinder escape for the rest. Where it is possible to identify people with special needs it is best practice to identify the problem and make provision to accommodate it.

How quickly are people likely to react to a fire emergency?

There is an unrealistic expectation that as soon as a fire alarm is raised all persons who hear it will immediately react and start to make their escape. This is rarely the case and fire safety specialists recognise that the time it takes for people to react is usually significant.

Reaction time (often called start-up time) is the time taken for appropriate action to be taken by a person in a fire emergency. The person's role, training, experience and awareness, as well as human behaviour, are all key factors in reaction times.
A person’s reaction to an alarm may include:

No Reaction - Not understanding what the alarm signal means.

Ignoring the Alarm – Reactions such as; “It does not apply to me”; “Someone will let me know if it's serious”. "I am not going outside in the rain”

Delayed Reaction – such as; “I must just finish this letter first”; “go to the toilet”; “finish my lunch”; “fetch my coat”; "phone the manager to see if it’s a test”.

Human Behaviour

An understanding of human behaviour is essential in formulating escape schemes for premises. There has been extensive research undertaken on this subject and thousands of real fire case histories have been closely examined, along with interviews of those involved. Experimental research has also been undertaken. It is impossible to capture all the aspects of human behaviour in this short section, but the following paragraphs show common assumptions about human behaviour in italics, and the known actual behaviour immediately after.

People panic in a fire emergency and display inappropriate behaviour.

Panic is an over-used and often misused term, especially in the media. It is so frequently used that most lay people now assume it is a normal reaction to a fire emergency.

However, analysis of real fire case histories reveals that people do not “panic” until they feel their life could be threatened, by which time it is often too late to make an escape.
People start to move as soon as they hear an alarm and a person’s escape time is dependent on how long it takes to move to and through an exit.

When people hear an alarm, time will elapse between the first hearing and when the person starts to move. “Start-up” time is a significant part of the evacuation time.

Unless trained and knowing what to expect, some people will be confused by a conventional alarm bell, siren, warble etc. Often people will not understand the alarm or even ignore it, waiting for other indicators or signals before deciding what action to take.

In addition, when asked about fire emergencies people tend to expect to see a fire. As a result people often do not appreciate the other warning signs that fires can give, such as the sounds of breaking glass, crackling sounds, slight smell of smoke, other distant or muffled noises, etc. and tend to ignore them, or investigate (see below).

A person’s first reaction to a fire emergency is to escape.

Human beings are inquisitive by nature. There have been many documented cases where people have attempted to investigate when they hear a fire alarm, or become suspicious that “something” is going on. As a result, many people will initially move closer to the danger area, rather than move away to safety.

People are most likely to move towards the exit they are nearest to.

In most buildings, people are familiar with the normal entrance and exit. Instinctively people will try to use these familiar routes in preference to the unfamiliar territory of dedicated fire escape routes, even if these routes are closer.
People move independently of each other, unless part of a dense crowd.

People will try to go against the flow of evacuees if they want to reach a loved one.

People always follow fire exit signs to find their way out.

Signs are not always noticed. Indeed in some premises the architects and designers deliberately try to make them as discreet as possible. Conversely, people will sometimes notice signs but still use their own spatial awareness and judgement to decide on the best direction to escape.

People will not use a smoke filled escape route.

People are often prepared to move through light smoke. Only when visibility drops will they turn around and try to get out another way. Visibility of less than 2m will usually deter use.

All people will be able to move towards and through exits at the same rate.

People will have differing levels of mobility and movement speeds.

How to overcome these difficulties and challenges

The training a person has received and their experience or awareness of the danger of fire will be a significant factor in their reaction to an emergency.

Trained groups such as the Armed Forces, Nurses, School Children, Police, etc., who are used to working in a disciplined environment are
more likely to behave in an orderly and disciplined way than members of the public at a night club, football match or shopping centre.

Staff fire training is vitally important to help overcome some of the behaviour and traits discussed in this section. Trained and disciplined staff will not only keep themselves safe, but will help keep others safe by stewarding them safely out of the building.
Construction

Fire & Rescue Service personnel usually receive training and possess some knowledge and experience about building construction, building materials and their performance in fire. This handbook will restrict itself to those matters relating mostly to fire safety and means of escape. Further information can be found in the Fire Service Manual Vol. 3, Fire Safety.

For fire safety, building construction can be classified into two types, primary and secondary.

Primary Construction

Primary construction is the main fabric of the building i.e. external load bearing walls, floors and some internal walls. It is designed to ensure stability of the structure (including under fire conditions), limit fire spread and achieve acceptable MOE.

The fire resistance of structure will be determined by the buildings proposed use and its dimensions. For many buildings the weight loadings on the structure require substantial structural elements, the fire resistance of which will far exceed that required for fire safety.

For fire safety purposes, primary construction is divided into three classes:
Class A

Structure constructed completely of non-combustible materials, i.e. concrete, stone, brick, steel, etc. Generally, Class A structures perform well in fire.

This picture shows the construction of a hi-rise building using concrete floor slabs manufactured on site and lifted into position. The central staircase, lift and services core can be clearly seen. It is this type of structural fire resistance, coupled with good fire compartmentation that allows these larger buildings to be used safely and facilitates fire evacuation strategies such as phased or delayed evacuation (sometimes referred to as “stay put”).

Many large new buildings in the retail, industrial and distribution sectors are successfully built from steel frames.
However, when exposed to fire, materials such as steel, can expand and begin to lose its strength (typically + 300°C) causing deformation and collapse.

Where a steel structure is required to resist failure, additional fire protection measures will be necessary, usually by insulating the structural elements from the effects of heat.

Some unprotected steel frame buildings with large span portal construction can be particularly vulnerable to inward collapse in severe fires.

An example of portal frame construction

© Page Concrete and Steel Limited, Crediton, Devon

Inward collapse of portal frame
Class B

Traditional construction, i.e. non-combustible walls with combustible floors and roof. Buildings of traditional construction usually perform less well in serious fires.

Severe fires can result in the walls losing the support of floors and roofs, which in turn can leave them standing but unstable.

Class C

Completely combustible construction - i.e. timber floors and walls. Conventional Class C buildings usually have very poor performance in fire. Unless additional protection is provided it is common for such buildings to be completely consumed by a severe fire.

Aftermath of a fire in single storey textile factory in Derbyshire. One of the roof mounted extraction fans had been malfunctioning. This was reported but ignored for several weeks before it eventually caught fire. The building was made completely of wood.
However, large section timber structural elements can perform reasonably well in a fire. Timber does not significantly expand when heated. When exposed to flame the surface forms a char layer which gives some protection to the remaining timber. There have been many instances where unprotected steel and concrete structural elements have failed in a fire, but large section timber elements have continued to function.

Despite deep charring, these large cross section timber columns and beams remain structurally stable.

The key factor is the size and cross sectional area of the timber elements, plus the timber species and any treatments it may have undergone.

Modern architects and developers are increasingly turning to laminated timbers, to create innovative designs. Laminating timber in this way creates structural elements which can be made into a variety of bespoke shapes. They are stable (much less likely to twist, split, warp or shrink) and have greater load carrying capabilities than “natural” timber of the same size.
Laminated timbers often perform well in a fire, behaving in a similar way to timber of large cross sectional area.

The construction industry is increasingly exploiting the environmental and economic benefits of constructing larger buildings with lightweight timber (small cross-sectional area) and high levels of thermal and acoustic insulation (often highly flammable). These buildings can quickly become structurally unstable as timber joists and framing burns through. For these reasons, adopting defensive tactics early in a fire incident can sometimes be necessary for fires in such buildings.

Typical modern lightweight timber construction.

Large timber building on the left (under construction) has been completely destroyed within 15 minutes of outbreak of fire. A separate but adjacent timber building (right) is well alight after being ignited by the original fire.
Other construction methods

In the pursuit of improvements to energy efficiency, functionality, cutting costs and ease of build, many different methods of construction have been, or are being used.

Some methods are known to be problematical with regard to fire performance, such as CLASP buildings and buildings constructed of (or lined with) “sandwich panels” with combustible core insulation.

Consortium of Local Authorities Special Programme (CLASP)

In response to post WW2 demand for new buildings, in 1957 a consortium of Local Authorities initiated a project to create a modular pre-fabricated building system to produce low cost, easy assembly public buildings, such as schools, libraries, old people’s homes, offices, etc. Made of lightweight steel structure with combustible cladding and linings, these buildings were manufactured in factories and assembled relatively quickly on-site.

Despite the systems many advantages, unfortunately, it soon became obvious that resistance to fire and fire spread in these early buildings was not adequate.

The CLASP system evolved and improved over the years to produce a number of identifiable “generations” of building types.

18 residents killed
In 2005, in recognition of this change, the CLASP method came under the control of Scape System Build Ltd (a local authority controlled company).

Today, a variety of CLASP and SCAPE building can be encountered. Early CLASP buildings should be treated with caution as their fire performance can still be very suspect, even if they have had their fire precautions upgraded.

Sandwich panel construction

A sandwich panel is the general term given to a building product consisting of an internal insulating core (polystyrene, polyurethane, rock-wool, etc.) sandwiched between an inner and outer skin, usually made of coated steel. These panels are commonly used, especially to meet insulation and hygiene criteria (food preparation, factories, cold stores, etc.).

A polystyrene core panel split open.

If the panels have combustible cores they will probably not perform well in a fire and the building structure is very likely to become quickly involved. In addition, the environmental impact of such fires is very detrimental.
Buildings with combustible insulated core panels, or a significant amount of combustible insulation, must be regarded as potentially high fire risk and FRS’s usually have special operational procedures to deal with them.

![Test fire in compartment made from insulated building panels made with combustible Polyisocyanurate core.](image)

**Future developments**

Many other innovative construction methods and materials are being used or experimented with. For example, recycled tyres, mobile phone cases and similar materials have been reformed into building materials.

Whilst the fire performance of traditional and conventional construction methods are known and predictable, for some of the new materials and building systems there is little or no real fire data to confirm their actual performance.

Another feature of modern buildings is that for economic and environmental reasons, greater attention is being given to thermal and acoustic insulation. A wide variety of insulation materials and products are being incorporated into building design.
Flammable insulation materials are usually protected by fire resistant linings, but if these lining are breached in any way (e.g. during construction, as a result of DIY efforts, or by a serious fire), then fire can spread through them.

A section through structural building component consisting of timber chipboard and polystyrene core insulation. Outer and inner surfaces will be clad with weather proof and fire resistant materials.

This building system is used to create domestic dwellings quickly and cheaply by manufacturing the building in modular form off-site, and quick assembly on-site.

Compartment fires penetrating into the buildings structural fabric are not uncommon and firefighters have reported great difficulty in stopping fire spread through a building as the fire travels through the insulation.

In the photos above, the fire started in a flat. Firefighters spent more than 20 hours chasing this fire in the timber framed building as it slowly but surely spread within its insulated wall cavities.

(Photographs courtesy of Dr Jim Marsden CEng BEng CFIFireE (Director of Ignis Associates Ltd, Consulting Fire Engineers)
Grenfell Tower, London, 2017

At the time of writing, the cause of this tragic multi-fatality fire, and why it spread so quickly, is still under investigation. Observers have expressed concern about the fire performance of the aluminium composite material (ACM) used as the external weather screening, and the Polysocyanurate insulation material that was used in this building’s exterior cladding system. The incident is now subject to a public inquiry, where such matters will be examined in detail.
Fire compartmentation

In addition to the basic function of primary construction, steps may have to be taken to:

- Minimise the size of any potential fire;
- Minimise the potential for fire and smoke spread around the building;
- Provide additional fire resisting features for means of escape and to aid firefighting.

To achieve this, larger buildings are usually divided into fire compartments.

The difference between basic primary fire resisting construction and fire compartmentation is that any wall or floor designated as fire compartmentation must not allow fire or other products of combustion through, or around it.

Fire compartmentation should provide a complete fire barrier, whereas basic primary fire resisting construction does not necessarily do so because its function is different (i.e. to stop the building falling down in the event of a fire).

A good example of fire compartmentation in action. The buildings new extension was separated from the old by a 60 minute fire resisting wall. The old building was destroyed by fire, but the new section survived.

Fire resisting compartment walls or floors will invariably require openings for the passage of people and building services, ducts etc. Fire resistance will be maintained by using fire doors and fire stopping materials and devices.

**Fire doors**

Properly installed and well maintained fire doors are an effective means of containing fire and smoke.

Unfortunately their importance is usually under estimated and they are often subject to abuse and neglect by occupiers who do not understand that in the early stages of a fire a closed fire door will hold back killer smoke, buying time for people to escape.

Fire door design has evolved over the decades and many different types may be encountered in premises.
Fire Doors will usually be either:

1. Doors constructed to older standards
2. “Made-Up” Doors (existing doors modified)

Note: Not all-existing doors are suitable for making-up to fire door standards. Any method of making-up must conform to some standard that has been tested and approved by an accredited test centre, e.g. The Timber Research and Development Association [TRADA].

Whatever doors are encountered they will initially have been designed to achieve certain standards, which will include: stability, integrity and insulation.

Stability = Resistance to buckling or deforming when subjected to fire.

Integrity = Resistance to the passage of fire through the door leaf and frame.

Insulation = Resistance to the passage of heat through the door leaf and frame.

Modern fire doors are manufactured to a minimum of 30 minutes fire resistance but other periods of resistance can be purchased (20, 60, 90, 120 minutes, etc.). These ratings are assessed by submitting the manufacturer’s door assembly (leaf, frame, door furniture, etc.) to an accredited test centre where they will be subjected to a standardised fire test (such as specified in BS 476, Part 22).
When a door is rated as being 30 minutes fire resisting it does not necessarily mean that it will perform exactly the same way in a real “non-standard” fire. If the installation does not conform exactly to the manufacturer’s instructions, performance can be detrimentally affected. Damage, wear and tear can also reduce the doors fire performance. The fire resistance rating should be used simply as a guide.

**Common features of fire doors**

- Self-closing device
- Fire door sign
- Fire resisting door furniture
- Fire resisting door leaf and frame

**Other features (depending on the age and type of door) may include:**

- FR glazing
- Door stop
- Cold smoke seals or brushes
- Intumescent strip
- Additional hinge (3 in total)
- Fire and smoke resisting ventilation
Fire door assemblies are particularly vulnerable at the small gap between the door leaf and frame, and in tests, often start to fail in the upper sections in these areas. The maximum gap at the top and side should not be more than 4mm and 10mm at the threshold (floor).

Cold smoke seals and intumescent strips are used to combat this problem and will be fitted either to the door leaf or frame. They can be fitted as separate items or combined together (the most common method). Cold smoke seals or brushes fulfil the function of a draft-strip to stop the leakage of cooler smoke around the door leaf and frame. They will melt and fail as the intensity of the fire increases.

Intumescent strips contain a chemical compound that swells when subjected to temperatures in excess of 180°C. As the cold smoke seals melt and fail the intumescent strip will swell, effectively sealing the door and increasing its fire resistance.

Fire doors are frequently rendered ineffective by being wedged or held open. Sometimes this is done for simple occupier preference, sometimes because the door gets in the way of people passing through (particularly the elderly or people with disabilities who may find the door difficult to open or too heavy and swift to close).
Holding fire doors open in a casual and unapproved manner should never be condoned.

Fire doors can be held open but only when risk assessed and suitable control measures put in place, such as fitting an approved hold-open device linked to fire detection. Extinguishers are not approved!

Every complaint that occupiers make about fire doors can be fixed, either by adjustment, or the installation of appropriate equipment, such as “swing free” door closers, or automatic door openers, approved hold open devices, etc.

If a door is held open by some approved method or device then the door should be released and close when:

1. A smoke detector operates (if not a full system then a minimum of one detector fitted either side of the door)
2. The manual over-ride switch is operated
3. There is failure of the electricity supply
4. The fire warning system operates.
Fire Stopping

Any holes made in fire resisting compartment walls or floors to allow the passage of wiring, piping or ducting must be effectively fire stopped.

Inevitably over the passage of time, new openings will be required. A large market has been created to provide products to overcome the difficulties in breaching fire compartments.

Fire stopping materials can include: Fire resisting pillows, putties, mastics, intumescent pipe collars, ventilation grilles, etc.

Fire stopping materials can sometimes be incorrectly specified or installed (e.g. builders expanding foam used to block holes). If you have any concerns or doubts about any fire stopping, contact a specialist Protection Officer for advice.

Secondary construction

Secondary construction (often referred to as “second fix” items in the building trade) refers to all those building elements which do not fall under the category of primary construction. Examples could include internal partitioning, temporary non-load bearing walls and screens, wall linings, floor coverings, fixtures and fittings etc.

A fire-resisting wall will provide an effective barrier to fire by stopping fire passing through it. However, fire may be allowed to pass along its surface if it is covered with a combustible material.
Wall and ceiling coverings are therefore required to achieve certain standards of “surface spread of flame rating” (as UK and EU testing regimes become more harmonised this term is rapidly being superseded by the European term “Reaction to Fire”).

Ratings for different products have been arrived at by testing them on rigs, which expose them to radiant heat. The time it takes for fire to spread along the sample is used to calculate the surface spread of flame (SSF) rating.

BS test for surface spread of flame. The glowing furnace is to the left and the product being tested is at right angles to it.

The extent and speed of flame propagation along the sample will be monitored and given an appropriate rating.

There are differences between the EU and UK testing and rating systems. For the purpose of this handbook, UK SSF ratings will be used in common with the HM Government Fire Risk Assessment Guides.

**Surface spread of flame rating (UK)**

In corridors, staircases and circulation areas for means of escape, Class 0 will be required.

**Class 0**

Will not support combustion. Examples include: brickwork, block work, concrete, plasterboard, ceramic tiles, plaster finishes (including rendering on wood or metal laths), wood-wool slab, thin vinyl, and paper coverings on inorganic surfaces (other than heavy flock wall paper) and certain thermosetting plastics.
In all other rooms (Except small rooms. See below) Class 1 will be required.

**Class 1**

Such materials include all the Class 0 materials referred to above. Additionally, timber, hardboard, block-board, chipboard, heavy flock wallpapers and thermosetting plastics if flame-retardant treated to achieve a Class 1 standard.

In small rooms (< 30m$^2$ non-residential, or 4m$^2$ in residential premises) class 3 may be permitted.

**Class 3**

Examples include: timber, hardboard, block-board, chipboard, heavy flock wallpapers, thermosetting plastics and thermoplastic linings (expanded polystyrene tiles) that have not been flame-retardant treated.

Surface spread of flame ratings for wall and ceiling linings are very difficult to ascertain by sight only. Manufacturers produce a great variety of satisfactory products and in some cases existing linings can be coated to rectify unsatisfactory ratings.

Fire will still spread rapidly through a Class A building if the secondary construction items are made from unsuitable combustible materials, or if wall and ceiling linings have been inappropriately selected. Secondary construction plays a vital role in achieving good MOE.
Time

Typical fire development and the time available for evacuation are often underestimated by members of the public. The concept that a well-ventilated fire with a good fuel load can develop exponentially (at an accelerating rate) is often not understood.

As the simple time versus temperature graph below shows, a fire may have a relatively slow initial rate of development, but as the energy release increases, so does the rate of energy release. Flashover often marks the rapid transition from partial to full fire development.

The period of time from when a fire ignites to when the conditions within the compartment or building become untenable is the time available for escape. This time is sometimes referred to as Available Safe Egress Time (ASET).

Fire Development - Time and Temperature Curve
(Note: curves may vary considerably depending on conditions, etc.)
Fire-fighting zone = initially first aid firefighting using portable extinguishers etc. If not easily extinguished, and as conditions deteriorate, professional fire-fighting must take over.

Fire safety zone = in an ideal world the fire safety measures taken in the premises should prevent outbreak in the first place. However, in the real world, the fire safety measures taken should assist with dealing with the emergency, including aiding professional fire-fighting intervention (as shown by dotted line).

For means of escape a judgement has to be made as to what are suitable target evacuation times from the area of the risk to either ultimate or comparative safety. The time available for escape will vary according to fire risk, the construction of the building and the nature of the occupancy.

For general purposes, targets are: -

- 2 minutes for Class C Construction
- 2.5 minutes for Class B Construction
- 3 minutes for Class A Construction

However, this is not always appropriate or practical for all types of premises. Some may be of such high risk as to require everyone to evacuate in seconds (e.g. flammable paint spray booth) whereas other occupancies require specific evacuation strategies which will deviate away from general purpose targets set out above.

Examples of where different evacuation strategies and times apply include:

- Where people with disabilities are likely to be present
Protection Handbook

- Hospitals
- Residential and nursing care homes
- Prisons
- Residential blocks of flats

Some of these types of premises will be dealt with elsewhere in this handbook.
**Travel Distance**

Travel distance is the distance a person has to actually walk to reach their nearest ultimate or comparative safety.

Much research has been done to try to ascertain the speed at which people will walk and figures between 2 or 3m/sec for able bodied, and between 0 to 2m/sec for a crowd moving along a corridor have been recorded.

There is a relationship between the time available for evacuation and how far people can walk in that time. Travel distances are one way of providing an approximate relationship with available escape time.

The acceptable travel distance will vary up and down according to the risk. Higher risk premises and/or where there is escape in only one direction (a dead-end) will need short travel distances. Lower risk and/or routes with alternative exits will be allowed longer distances.
As a guide, travel distance tables are given in the Building Regulations Approved Document B and other Guides, Codes of Practice and British Standards.

As travel distances vary with building construction, a premises use and overall risk profile, there will be significant variations to the distances recommended.

Because of the expertise required to interpret guidance and apply the appropriate travel distance, reference to such detailed information is usually undertaken by specialist Protection Officers rather than Operational personnel.

The Government’s Fire Risk Assessment guides provide some advice to Responsible Persons and fire risk assessors. These guides are generally for simpler premises and are based on the recommendations within the Building Regulations Approved Document B – Fire Safety.

Examples of travel distances from DCLG Fire Risk Assessment Guides:

**Offices & Shops**

<table>
<thead>
<tr>
<th>Escape routes</th>
<th>Suggested range of travel distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where more than one escape route is provided</td>
<td>25m in higher fire-risk area(^1) \n 45m in normal fire-risk area \n 60m in lower fire-risk area(^2)</td>
</tr>
<tr>
<td>Where only a single escape route is provided</td>
<td>12m in higher fire-risk area(^1) \n 18m in normal fire-risk area \n 25m in lower fire-risk area(^2)</td>
</tr>
</tbody>
</table>

\(^1\) Where there are small high-risk areas this travel distance should apply. Where the risk assessment indicates that the whole building is high-risk, ask advice from a competent person.

\(^2\) The travel distance for lower risk premises should only be applied in exceptional cases in the very lowest risk premises where densities are low, occupants are familiar with the premises, excellent visual awareness, and very limited combustibles.
## Sleeping Risk Premises

<table>
<thead>
<tr>
<th>Escape routes</th>
<th>Suggested range of travel distance Note 3, Note 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where more than one route is provided</td>
<td>18m in a bedroom(^{\text{Note 1}}) and higher fire risk area(^{\text{Note 2}})</td>
</tr>
<tr>
<td></td>
<td>35m in normal fire risk area</td>
</tr>
<tr>
<td></td>
<td>45m in lower fire risk area(^{\text{Note 3}})</td>
</tr>
<tr>
<td>Where only a single escape route is provided</td>
<td>9m in a bedroom(^{\text{Note 1}}) and higher fire risk area(^{\text{Note 2}})</td>
</tr>
<tr>
<td></td>
<td>18m in normal fire risk area</td>
</tr>
<tr>
<td></td>
<td>26m in a lower fire risk area(^{\text{Note 3}})</td>
</tr>
</tbody>
</table>

**Note 1:**
Bedrooms include all sleeping rooms e.g. dormitories. The travel distance within a bedroom should be restricted, however, this distance can be included as part of the overall travel distance to a protected stair or final exit. For example, if the travel distance within a bedroom (a single escape route) is 9m and the corridor has two escape routes in a normal fire risk area, the travel distance from the bedroom to the nearest protected stair or final exit is (35m minus 9m) 26m.

**Note 2:**
Where there are small higher risk areas this travel distance should apply. Where the risk assessment indicates that the whole building is higher risk, seek advice from a competent person.

**Note 3:**
The travel distance for lower risk premises should only be applied in exceptional cases in the very lowest risk premises where densities are low, occupiers are familiar with the premises, have excellent visual awareness, and very limited combustibles.

## Factories & Warehouses

<table>
<thead>
<tr>
<th>Escape routes</th>
<th>Suggested range of travel distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where more than one escape route is provided</td>
<td>25m in higher fire-risk area(^{\text{Note 1}})</td>
</tr>
<tr>
<td></td>
<td>45m in normal fire-risk area</td>
</tr>
<tr>
<td></td>
<td>60m in lower fire-risk area(^{\text{Note 1}})</td>
</tr>
<tr>
<td>Where only a single escape route is provided</td>
<td>12m in higher fire-risk area(^{\text{Note 1}})</td>
</tr>
<tr>
<td></td>
<td>25m in normal fire-risk area</td>
</tr>
<tr>
<td></td>
<td>45m in a lower fire-risk area(^{\text{Note 3}})</td>
</tr>
</tbody>
</table>

**Note 1:**
Where there are small higher-risk areas this travel distance should apply. Where the risk assessment indicates that the whole building is higher risk, seek advice from a competent person.

**Note 2:**
Some rooms are considered as places of special fire hazard, e.g. rooms used for highly flammable paint spraying. Shorter travel distances are generally required for these areas, e.g. 18m where there is more than one escape route, and 9m with a single escape route.

**Note 3:**
The travel distance for lower risk premises should only be applied in exceptional cases in the very lowest risk premises where densities are low, occupiers are familiar with the premises, excellent visual awareness, and very limited combustibles.
When assessing MOE, if people cannot walk to safety within an agreed travel distance, then safety must be brought to people. This is achieved by creating protected routes.

A protected route is an escape route which is adequately protected from the rest of the building by fire resisting construction (as shown by the red lines depicted in the drawing above). Once a person enters the comparative safety of a protected route the travel distance is no longer measured as they are deemed to be protected from fire and smoke.

Double fire resistance is provided at basement level to help alleviate some of the problems associated with means of escape and known firefighting difficulties that are frequently encountered in basement fires. The Building Regulations also make provision for the safe venting of heat and smoke from basements (e.g. smoke outlets or mechanical ventilation), so firefighters should be vigilant for such facilities and if necessary exploit them to aid their firefighting efforts.
Exits

It should be noted that all the topics covered in this section (the numbers of exits required, their widths and locations, escape routes, etc.) will have been determined at the design and build stage by architects, building control officers and Protection officers. Therefore the details given in this handbook are for background information only.

The movement of people escaping in a fire emergency is usually considered in three stages:

1/ horizontal movement within rooms;

2/ horizontal movement in corridors and circulation spaces and;

3/ vertical movement on stairs.

Horizontal Movement Within Rooms

The best practice for means of escape is to allow people to be able to turn their back on the fire and walk towards the nearest exit. In some types of premises there may be restrictions on maximum travel distances within a room. Please see the previous travel distance tables for further information.

Walls, partitions, fixings and furniture should provide identifiable escape routes, which are easy to use, do not unnecessarily add to the travel distance and do not have any narrow “bottleneck” restrictions.

Routes should be signed and well lit.
Door fastenings

All fire escape exits, along with any doors along the escape route, must be fitted with the correct type of door furniture. The fire risk and the number of people that will have to use the exit have to be considered when specifying the type of door fastening. The lock and security industry is well aware of the problems of balancing security with MOE and as a result produces a large selection of locks and fastenings which will meet varying requirements.

Exit doors from all high risk areas must be either:

- Free of fastening
- Panic Bar or Latch
- Push Pad*

*Push pads are only suitable for single leaf doors. If double doors are required for MOE then panic bars should be fitted.

The specification of normal and low risk premises door fastenings will depend on the number of people expected to use them and whether members of public are included.

For example, in premises of normal or low fire risk, and with only 10 staff almost all types of door fastening are acceptable. Increase the number and greater attention has to be given to ease of use.

Premises where members of the public can be expected to be present require even more consideration as to ease of use, even if numbers are very low.
The greater the number of people, the higher the risk, the easier the door fastening must be to use. Staff must be aware of the method of operation of any specialist fastening. Method of operation signs may be required. Exit doors not in normal use should be operated at least once a month to check they still work.

When assessing the suitability of door fastenings a fundamental question would be "does the fastening permit the people who will have to use it easy access to their escape route?"

If the fastenings are locked shut, stiff, seized, poorly maintained, fiddly or there are lots of them to undo, then the answer to the above question has to be no.
Number & widths of exits

The number and width of exits required from any room or premises is dependent on: fire risk; the number of persons expected to be present; and the target evacuation time.

If low numbers of persons are present (50 to 60), one-way travel distance is ok and the fire risk is normal or low, then one exit is acceptable and the door to it may open inwards. However, it is always desirable to provide alternative exits whenever possible.

When assessing means of escape provision and where more than one fire exit is provided, it is assumed that the largest of them will be blocked by the fire and unusable. The remaining exit(s) must have sufficient escape capacity for all persons with this exit lost.

The number of persons that can physically pass through an exit in a given period of time is critical in calculating what exit capacity is required to achieve the target evacuation time.

It is not expected that FRS Operational personnel will be involved in such an assessment, but for information only, the following figures have been taken from Fire Safety Approved Document B (2007 amended version).

<table>
<thead>
<tr>
<th>Persons</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>750 mm</td>
</tr>
<tr>
<td>110</td>
<td>850 mm</td>
</tr>
<tr>
<td>220</td>
<td>1050 mm</td>
</tr>
<tr>
<td>More than 220</td>
<td>5 mm per person (at least 1100mm)</td>
</tr>
</tbody>
</table>
Exit location

Having decided on the exit widths and the number of exits that will be required for the occupancy, the next step is to determine exit location. Exit location is important in achieving good MOE.

When a room requires an alternative exit for means of escape (e.g. because of excessive travel distance and/or numbers of people) then the 45° rule must be satisfied.

If the exits are less than 45° apart then they cannot be deemed to be true alternatives to each other as a fire in the vicinity of either one is very likely to block both simultaneously. In these circumstances the one way travel distance and single exit guidance will have to be applied.
**Inner rooms**

Some rooms are configured so that access and escape is only possible through an access room. Such a room would be referred to as an inner room.

Should a fire break out in the access room, any persons in the inner room might initially be unaware of the developing hazard and become trapped.

To help overcome this problem, inner rooms should be provided with some way of warning the occupant that their MOE is at risk.

Methods of giving warning can include any of the following: vision panel(s) between inner and access room; smoke detection in access room; security cameras scanning access rooms, with monitor in inner room; reduce height of partitions to 500mm from ceiling; remove door to inner room.

MOE should never be through an access room of higher risk.
A room, inside a room, inside a room, is called an inner, inner room. Inner, inner rooms are almost never accepted. Only in exceptional circumstances, with additional compensatory features provided, will a Protection officer consider this option.
Horizontal Movement in Corridors & Circulation Spaces

Corridors and circulation spaces provide the second stage of horizontal escape. They should be designed and managed to be of lower fire risk and are not supposed to be used as “rooms” unless additional precautions are taken.

It is assumed that the width restriction of the average corridor tends to encourage smoke to travel along its length more quickly. This is undoubtedly the case where a fire is directly venting into the corridor, or within the corridor itself.

Research has shown that smoke percolating through a closed fire door into a corridor has the effect of cooling the smoke, causing it to lose buoyancy and drop. Tests have shown that under such circumstances a corridor may slowly smoke log, and activation of smoke detection can be delayed.

Any corridor more than 30m should be sub-divided to stop passage of smoke.

Ideally all corridors should allow for escape in two directions. For some corridors this is not possible and escape can only take place in one direction (a dead end).

The problem with dead-end corridors is similar to the problems with inner rooms. Any person in a room off the dead-end corridor will be unaware that their means of escape is becoming compromised by a fire in another room. They could easily become trapped as the corridor fills with fire or smoke.
Where a dead-end corridor exists, additional means of escape measures will have to be taken. These can include:

- Providing fire detection in rooms off the corridor to give early warning;

- Providing structural fire protection to hold back fire and smoke.
Providing an alternative exit to restore escape in two directions.
**Vertical Movement in Staircases**

Whenever possible it is always best to have alternative stairs.

Staircases can be divided into:

- Accommodation stairs (Not considered as MOE)
- Unprotected stairs
- Protected stairs

Accommodation stairs: These are unprotected stairs provided for the convenience of occupants and are in addition to the minimum MOE requirements. Whilst many people will use these stairs in an emergency, they are in fact deemed to be surplus to requirements. The means of escape should function perfectly without them.

**Unprotected staircases**

Staircases are potentially chimney flues for the spread of fire and fire gases. In all but small premises, MOE stairs and accommodation stairs will have to be separated from the rest of the building by fire resisting construction.

Travel distances will continue to be measured within unprotected staircases.

**Protected staircases and protected routes**

If satisfactory MOE cannot be achieved then staircases and routes out of the building may be upgraded to protected status. This will in effect take safety to people rather than people to safety.

Protected routes should discharge direct to a final exit or have final exits separated by FR construction.
Protected staircases and routes should be fire sterile environments protected from the ingress of fire and the products of combustion.

Once inside, people should be able to make their escape without further difficulty or danger. Travel distance will no longer be measured once a person steps inside the comparative safety of a protected staircase and route.

Depending on the height, construction and layout of the building, additional protection from fire and smoke will be from either:

- Fire resistant fire compartment walls, single fire door and smoke detection;
- Fire resistant fire compartment walls, single fire door and corridor/lobby approach;
- Lobby approach;

The effect of a corridor or lobby approach to entering a staircase enclosure is to provide a smoke reservoir effect which will trap smoke or impede its progress into the protected staircase.
Protected routes should not contain any fire hazard such as:

- Portable heaters, naked flame heaters, oil filled heaters, boilers
- Cooking appliances
- Stored furniture
- Temporary storage
- Lighting using naked flame
- Gas meters (unless correctly installed according to regulations)
- Coat racks
- Photocopy or vending machines

Eliminating potential ignition and fuel sources in this way is of vital importance if the building has only one staircase. If the building has multiple staircases then a risk assessed approach can be taken.
Other means of vertical escape

An external fire escape is sometimes provided where problems with providing an internal staircase are encountered. A risk assessment of such a staircase should include checking that it is in good usable order and is adequately maintained (corrosion, mould growth, wet leaves etc.).

Checks will also have to be made to ensure that walls and any openings within 1.8m of the stairs are fire resistant.

Vertical and raking ladders may be encountered in plant rooms and similar environments. They are only suitable for low numbers (<10) of able bodied persons who are not members of the public.
Means of Escape for People with Disabilities

Disability can come in many forms and with varying degrees of severity. It is not possible to provide a “one size fits all” solution to means of escape for disabled persons. This handbook attempts to set out the main issues in general and broad terms.

Under current fire safety legislation it is for the person(s) having responsibility for the building to provide a fire safety risk assessment that includes an emergency evacuation plan for all people likely to be in the premises, including people with disabilities. They will also have to ensure that the plan will be successfully implemented when required.

Such an evacuation plan should not rely upon the intervention of the Fire and Rescue Service to make it work.

Where an employer or a service provider does not make provision for the safe evacuation of disabled people from its premises, this may be viewed as discrimination. It may also constitute a failure to comply with the requirements of the FSO.

Jessica Cox, Arizona, December 2008

Jessica was born with no arms. She became the first pilot to fly a plane using her feet.

Means of escape for people with disabilities is best achieved with the collaboration and co-operation of the person with the disability.
Generally, disabled people are no different from anyone else in that they prefer to be in control of their own escape. The Equality Act 2010 requires that adaptations may be made to physical features of buildings to enable them to be used more easily by disabled people.

The person with the disability will know their own capabilities and is best placed to advise the person with responsibility for fire risk assessment and evacuation planning as to what is required to help them escape.

If necessary, further advice and guidance can be obtained from one or more of the charities and bodies that support or work with people with disabilities.

For staff and regular visitors to the building or premises, discussions and negotiations should take place to establish what can reasonably be achieved. Disabled people also need to understand the limits of reasonableness set out by the Equality Act.

The aim of these discussions should be to establish a Personal Emergency Evacuation Plan (PEEP) for every disabled person. Colleagues and other staff will need to be aware of the PEEP and what (if any) role they have in implementing it.

For buildings and premises where people with disabilities may be occasional or infrequent visitors (e.g. shopping mall, hotel, etc.), one or more Standard PEEPs can be prepared. When a disabled person visits a premises they can be shown the standard PEEPs and select the one (or combination of PEEPS) which is most suitable for their capabilities.
Standard PEEPS should take account of the following:

- the disabled person’s movements within the building;
- the operational procedures within the building;
- the types of escape that can be made available;
- the buildings systems (e.g. the fire alarm), and;
- the existing egress plan.

**General principles**

Many, if not most people with some form of disability will be able to make their escape along with everyone else. Some people will need some assistance, whilst others will not be able to escape without full assistance.

For people who need little assistance the PEEP may only involve organising and training colleagues or other staff to provide that assistance (e.g. giving someone a guiding arm along the escape route).

For people who need full assistance there is a concern that the extra time it may take for that person to escape could impede the escape of other able bodied occupants (e.g. two people assisting a wheel chair user down stairs could block the stairs for other users).

It is now an accepted practice that a disabled person who is not able to escape unaided can be temporarily held in a safe refuge until their escape can be affected, without Fire & Rescue Service assistance.
The Refuge Concept

Refuges should be signed safe areas protected from fire and the products of combustion. There should be sufficient space to accommodate those with disabilities and their assistants, without restricting or blocking escape routes. There should be a two-way communication system within each refuge so that the disabled person or their assistants can make contact with the buildings control room or reception area (or wherever the evacuation is being co-ordinated from).

Aaron Fotheringham. Extreme wheelchair athlete.
A plan of a refuge which includes access to a lift deemed suitable for use in a fire emergency.

Two examples of refuges, both within staircase enclosures.

The lifts throughout the building have been specifically designed for MOE (BS EN 81-70).
These photographs show examples of a corridor and staircase specifically designed to assist people with disabilities. Additional features include:

- extra width for ease of manoeuvrability;
- tactile floor coverings in selected areas to warn of hazards;
- colour contrast décor to help those with partial sight;
- differential lighting to highlight exit routes, exits, signs, etc. This helps those with partial sight to navigate around the building in day-to-day use and in an emergency;
- colour coded way-finding wall markings;
- automatic fire door opening devices;
- colour contrast nosing to top stair treads.
Means of Escape in Residential Flats

Firefighters frequently attend fires in residential flats and a common means of escape strategy encountered is for occupiers in unaffected flats to “stay put”. Some fire professionals prefer the term “delayed evacuation” although this must not be confused with the requirements for the escape strategy adopted in some residential and nursing homes.

Residential flats may be within converted buildings or purpose-built. The means of escape strategy for converted buildings will be dependent on the nature of the building and the type and quality of its active and passive fire precautions, so a “stay-put” strategy may not always be appropriate. For purpose-built flats, the means of escape strategy is nearly always “stay put” if unaffected.

Means of escape from residential blocks of flats with floors not more than 4.5m above ground is generally deemed to be fairly straightforward, but any building with storeys above this height require increasingly complex fire safety measures and a different means of escape strategy. High reliance is placed upon having effective fire compartmentation to resist fire and smoke spread.

Common design assumptions about a typical fire incident in these types of premises include:

- Any fire is most likely to occur within a flat and there will be a low probability of the fire spreading outside of the flat.

- Residents in other flats will be protected from the fire by the affected flat’s fire compartmentation (including its front door) and their own fire compartmentation, including their own front door. (Sometimes referred to as two door protection).
• If a fire does occur in a communal area (such as a corridor), the construction and materials used should prevent fire spread beyond the immediate vicinity.

• Fire is not likely to spread between floors via the external face of the building.

For these reasons it is usually deemed that the simultaneous evacuation of the building is unlikely to be required. Anything that weakens the basis for the assumptions outlined above can have a serious detrimental impact on means of escape and any firefighting tactics.

For example, in buildings it is not unusual for:

• Fire compartmentation to be breached, such as when penetrating fire resisting walls to allow pipes, cables or other services through.

• Front doors to be altered or replaced, detrimentally affecting their fire resistance.

• Re-decoration or refurbishment which alters reaction to fire ratings of surface finishes.

• Repairs and maintenance of the fabric of the building and its active and passive fire precautions to be neglected or incorrectly specified.

• External cladding to be retrospectively applied to the external faces of the building. This should not cause a problem, but if incorrectly specified, it can be disastrous in allowing fire spread.

• Fire to spread externally due to the wind and/or the Coanda effect.
On arrival at a fire incident, visual indicators such as rapid fire spread which appears to be breaching fire compartmentation, smoke appearing in unexpected places (sometimes remote from the original fire location) are all indicators that there is a problem. The incident commander will have to make a rapid assessment as to whether the fire compartmentation is being effective in containing the fire and protecting residents and whether the “stay put” strategy is still appropriate. If the building is a high-rise, this will add to the known complications of firefighting in such buildings and may have a serious detrimental impact on standard procedures (See Chief Fire and Rescue Advisor’s [CFRA] Generic Risk Assessment 3.2 – Fighting Fires in High Rise). An incident which highlighted some of the challenges that such a fire can present occurred in Lakanal House.


Originally erected in 1958, the building had inevitably been subjected to many changes over the decades.

The fire is believed to have started in a flat on the 9th floor but spread very quickly. Concerned residents calling London Fire Brigade were told to “stay put”, which should have been the correct fire strategy for the building.

Photo courtesy of and © Nigel Saunders & Paul Wood
Three women and three children died in the fire and many more were injured (including one Firefighter). Many survivors said they were not familiar with the alternative escape routes provided in the flats. The post fire investigation and inquest confirmed unusual and rapid fire and smoke spread (including downwards) due to unsatisfactory fire compartmentation. It was also concluded that most, if not all of the casualties could have escaped, if they had ignored the “stay put” advice.

For operational personnel, it is important that crews are familiar with any buildings of this type on their station ground. A visit to determine the layout of the building, its pre-planned means of escape strategy and to discover what firefighting access and facilities it has been provided with (e.g. fire mains, pressurised staircases, smoke ventilation, etc.) will be very helpful in any future incident.

A visit will also provide an opportunity for personnel to report any concerns they may have about the standard of fire precautions or firefighting access and facilities in the building. The Fire Safety Order applies to the communal areas within these types of buildings (this includes the front doors of the flats).
For serious matters an Enforcement Notice can be served requiring fire safety matters to be addressed and in extreme cases the Fire Authority can serve an Article 31 Prohibition Notice, which may include the private flats.
Means of Escape In Nightclubs & Similar Premises

Introduction

Whenever members of the public assemble in large numbers within a space, enclosure or building, the risk to their safety from unplanned hazardous events increases. History shows that building collapses, people being crushed or trampled underfoot and serious fires are all too common. It is no surprise that the management and safety of large numbers of people or crowds is a specialist subject which requires a high level of technical knowledge to accomplish. It follows that this course cannot delve into this topic too deeply. Instead, it will explore in some detail the problem of fire within licensed places of assembly such as public houses, nightclubs and similar premises, as these are most likely to be routinely encountered by operational personnel.

Major fires in such premises are all too frequent occurrences, as the list below illustrates:

- **Cocoanut Grove**, Boston, USA. Nov. 1942.
  492 people killed, hundreds injured *(the death toll alone was greater than the club's official occupant capacity)*

  19 people killed, many injured

  146 people killed and more than 50 injured
  165 people killed and over 200 injured

  48 people killed, 214 injured.

  82 people were killed and 27 injured

• **Ozone Disco Club**, Quezon City, Philippines. March 1996.  
  162 people killed and hundreds injured

  63 people killed and approximately 200 injured

  309 people killed (construction workers and dance hall patrons)

  14 people killed, 241 injured.

  100 people killed and 230 injured

• **República Cromañón Nightclub.** Buenos Aires, Argentina.  
  194 people killed and hundreds injured

  43 people killed, over 50 injured
**Santika Nightclub**, Bangkok, Thailand. 1<sup>st</sup> Jan. 2009.
66 people killed and 222 injured

156 people killed (some died many months after the fire) and more than 100 injured

+233 people killed and many injured

**Colectiv Nightclub**, Bucharest, Romania. October 2015.
53 people killed and more than 140 injured (note that at the time of writing, the death toll may be expected to rise)

13 people killed, and 6 injured.

This list of some of the most notable fires is not exhaustive. An internet search will quickly reveal the full case histories of these fires. To understand why these tragedies keep occurring it is worthwhile looking a little deeper at the nature of the risk.
The Nature of the Risk

The premises

The venue may be purpose built or converted premises. It is likely that the internal layout and décor will be such that it creates a welcoming and/or party atmosphere. There may be many changes of floor level, bar areas, raised performance stages and platforms, lowered dance floors, separate areas or nooks for seating, eating or conversation, etc.

Interior fixtures, fittings and décor are often chosen to create highly stylised and sometimes opulent interiors, often striving to achieve a “Wow” factor for patrons.

With the correct professional approach this can be safely achieved (photo courtesy and © of Showtec. Website: Showtech.co.uk).

But if this approach is not adopted, then dangerously flammable interiors may be the end result. (Photo: interior rush-matting ceiling of Lame Horse Nightclub ignited by “cold” fireworks)
Lighting

To help create a party atmosphere, many premises will use a mixture of subdued lighting, high intensity lighting and lighting effects (including lasers, strobes, etc.).

Stage effects

Some premises will use stage effects such as smoke machines, foam generators and pyrotechnics. Pyrotechnics designed and intended for interior use are sometimes referred to as “cold” fireworks. This is a misnomer as such fireworks are hot (+1000°C) and highly incendive*. In fact the main difference between interior and exterior pyrotechnics is that interior fireworks may have a slightly shorter duration, throw sparks a shorter distance, and they will usually produce much less smoke.

Noise levels

Amplified music and other sound effects are normal for such premises. In addition to the noise made by patrons, sound levels emitted by sound systems will drown-out any noise made by a fire (crackling, popping, glass smashing, etc.), or the shouts of people trying to raise the alarm. The ability to shut down sound systems immediately a fire is discovered is essential.

*Definition of incendive: Having enough energy to ignite a flammable substance or mixture
Occupants

Most customers will be in party mood, and the use (and abuse) of alcohol and drugs is commonplace. As a result, nearly all will have their guard-down and be vulnerable in the event of an emergency.

Disorientated & Disbelieving

For all the reasons outlined above it may be no surprise that survivors of fires in such premises often state that when they saw the first signs of the fire they mistakenly believed it was all part of “the show”. Delays in making their escape, the speed that conditions deteriorate, and confusion as to the quickest way out, are frequently reported by survivors.
Common Recurring Problems

With our knowledge of what constitutes good means of escape from fire acquired on this Protection Foundation course, one can study the circumstances of the numerous fires listed at the beginning of this chapter and easily identify common recurring problems that caused or contributed to the fire and resulting deaths and injuries. In no particular order, they are:

Unsuitability of the premises

Some venues have been created within buildings which were not originally designed for use as a pub, or nightclub. In the UK this can be safely achieved if the conversion followed the correct planning and Building Regulations approval process, and has been completed with all fire safety requirements satisfied.

On occasion, personnel will encounter a venue where this process has not been followed. Not only is this illegal, but such an approach is probably indicative of ignorance, or a reckless disregard for peoples safety from fire. Personnel discovering such unauthorised premises must default to assuming they may be dangerous and call for the attendance of a Protection Officer.

Overcrowding

Many of the major incidents listed were in buildings which were excessively overcrowded, thereby exceeding the means of escape capacity of the premises. Commercial pressure to maximise income and gain a reputation as being a popular venue can sometimes override safety considerations. It has been known for head-count recording to mysteriously stop at or near the maximum permitted numbers for the premises.
Locked and blocked exits

All too often internal and external exits are obstructed and sometimes locked or otherwise secured shut. Sometimes this has been done deliberately to make the premises more secure from unauthorised access and egress. It has been known for exits to be chained and padlocked, or even nailed shut.

It is also important to ensure that routes to emergency exits are identified and kept clear of obstruction. There have been several incidents where escape routes have been blocked or narrowed by inappropriately placed tables and chairs, or even storage of unused tables, chairs and other items.

Highly flammable wall/ceiling linings and décor

In the UK, wall and ceiling linings should have been controlled under the Building Regulations when the premises was built or converted. Unfortunately, when re-decorating, or trying to create a particular temporary décor (for example on a theme night) it is all too easy to accidentally or deliberately detrimentally change the flammability characteristics of walls and ceilings and create highly dangerous conditions. In many of the fires listed in this chapter, extremely rapid fire and smoke spread was a direct result of the presence of flammable linings, coverings and decorative items.

Experience has shown that floors, walls and ceilings are sometimes covered with painted cloth, carpet tiles, flags & bunting, camouflage netting, scrunched plastic bags, large quantities of crumpled paper, etc. Sometimes other decorative items are added such as artificial trees, Christmas decorations, etc. Stage sets for performers can also introduce highly flammable materials if not specified, designed and erected properly.
Use of stage pyrotechnics and other fireworks

Many incidents have been caused by the unsafe use of pyrotechnics, often igniting flammable wall and ceiling linings. The use of stage pyrotechnics should only be undertaken by experienced and licensed operatives and only after a thorough fire risk assessment has been completed and acted upon. Sadly, in several of the fires previously listed, this was not always the case.

Control of other naked flames and potential heat sources

Carelessly discarded smoking materials have been implicated in some fires, as have other heat sources such as lighting, faulty electrics, etc.

Arson

It is very difficult to counter a determined arsonist, but removing or reducing opportunities for an arsonist to strike is essential. The storage of items within escape routes and escape staircases have contributed to fire deaths, not only by reducing the required escape route widths, but also providing a route through which a fire can rapidly spread. Items stored in this way have been ignited by arsonists, with devastating consequences (e.g. deliberate ignition of stacked chairs within one MOE staircase at the Gothenburg Dance Hall Fire).
Fire Safety Audits and Checks

The management of such potentially high risk premises contributes significantly to the safety of premises and occupants. Such premises will be subject to periodic audit and inspection by specialist Protection Officers who will enforce the Regulatory Reform (Fire Safety) Order 2005.

These periodic checks will not necessarily be enough. Many fire and rescue services (FRS) also conduct spot-checks. These spot-checks can have different names but are often referred to as “During Performance” checks or inspections.

Whatever terminology is chosen the purpose of the visit will be the same, namely to call into the premises at, or near a time when it is most likely to be full and busy, to see if the necessary fire safety measures are being taken and maintained.

It is important to recognise that such visits are not full comprehensive audits. In essence, the visiting officers are the “eyes and ears” of the FRS and have the duty to call in a Protection Officer if they have concerns about the safety of occupants in premises, no matter what time of day the visit occurs, e.g. Dangerous Conditions.

FRS policies will differ, but typically, authorised personnel will visit unannounced before, or near times of peak activity in the premises.

Personnel should ask to look around the premises and in doing so should check for:

- Evidence of overcrowding
- That escape routes and exits are clear and usable
- That surface linings and décor appear satisfactory
- Whether pyrotechnics or other stage effects are used, or will be used, and whether their safety arrangements appear adequate
That staff appear to know the fire routine and evacuation procedure for the premises.

If personnel have any concerns they must consider whether they have encountered dangerous conditions worthy of an Article 31 Prohibition Notice, or whether other more formal fire safety enforcement action must be taken. It is always advisable to contact a Duty Officer to get a second opinion if there are any doubts as to what course of action to take.

**Serious Pitfalls to Avoid**

Making an official visit to a nightclub, or bar which is full of intoxicated people intent on having a good time can be fraught with difficulties. Personnel may find themselves being tempted by the atmosphere or individuals to “loosen up” and socialise. This must be resisted.

When conducting spot-checks of this type, personnel must:

- Understand the proper purpose, gravity and importance of such checks and that they have a duty to ensure public safety.

- Recognise that they are the ambassadors for their Service and scrupulous professional standards and attitude must be maintained.

- Any offers of hospitality from the host (such as free drinks, food, free entry on other nights, etc.) must be resisted as it may be seen or interpreted as compromising the independence and impartiality of the check.
• Remember that most premises of this type now have comprehensive CCTV coverage. In addition, nearly everyone inside is likely to have a mobile phone capable of taking photographs and video. It is all too easy to be the subject of a compromising photograph which can be rapidly circulated in social media or the Press. Personnel must be aware of this trap and the fact that they could be subject to formal discipline if caught in this way. The detrimental impact on professional lives and personal relationships could be very significant.

On a more positive note, with the right attitude and approach, personnel can make a big impact on public safety by carrying out “during performance” checks in this type of high life risk premises.
Means of Escape in the Health and Residential Care Sectors

Many of the basic principles of conventional means of escape will not be appropriate for all premises.

For example, prisons and secure premises will not want easy and rapid fire evacuation for all inmates. Specific constructional features and special arrangements are made for such institutions.

Similarly, hospitals and healthcare premises will not want to immediately evacuate all patients in the event of a fire emergency. To attempt to do so can be practically impossible, especially for non-ambulant patients, such as those who are bed-bound, in intensive care, or undergoing operations and surgical procedures.

Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare. Hospitals and health care premises are designed to have high standards of fire compartmentation (which will help contain a fire), sophisticated and comprehensive fire detection and alarm systems, and where appropriate, automatic fire suppression systems. Good management, well trained, vigilant and disciplined staff supplement these precautions. As a result, full fire evacuation of the entire building is unnecessary in anything other than the most dire and extreme emergency.

Residential and nursing care homes also experience similar problems with regard to evacuating residents. Residents who are bed-bound, elderly, frail, suffering from mobility, behavioural and cognitive problems (i.e. dementia, learning difficulties) can at best be difficult to
evacuate from a premises, and at worst, an evacuation in cold, dark and wet weather can cause stress, hypothermia, slips and falls, etc.

The Fire Risk Assessment guide (DCLG) for Residential Care Premises uses three classifications for residents:

**Independent**

Residents with virtually no impairment. They can escape without assistance.

**Dependant**

Residents who will require some assistance to escape. This category includes those with mental health problems regardless of their independent mobility.

**Very High Dependency**

Residents whose care and/or condition creates a high dependency on staff and where immediate evacuation would prove potentially life threatening.

The Guide suggests three possible evacuation strategies depending on the categorisation of residents:

- Single stage evacuation;
- Progressive horizontal evacuation;
- Delayed evacuation.

**Single stage evacuation**

This strategy is appropriate for “independent” residents and where it may reasonably be expected that all people in the building are able to (and will) evacuate immediately from the premises to a place of ultimate safety without assistance.
Progressive horizontal evacuation

This strategy is likely to be necessary for “dependant” residents who will rely on staff to assist with their escape. It works on the principle of moving residents from an area affected by fire, through a fire resisting barrier to an adjoining fire protected area on the same level.

Once evacuated to this place of relative safety they may be able to stay there whilst the fire is dealt with, but if deteriorating conditions or circumstances do not permit this, further evacuation down a protected route to ultimate safety must always be possible (i.e. a fire protected area must not be a dead-end).

Protected areas must have the capacity to accommodate their normal residents plus those residents who will be evacuated. Staff should be trained and able to conduct progressive horizontal evacuation and not be totally reliant on fire and rescue service intervention.

A diagram to illustrate the principle of progressive horizontal evacuation, showing protected areas.
Delayed evacuation

A delayed evacuation strategy (sometimes incorrectly referred to as a “stay-put” policy) is for exceptional circumstances and only for very high dependency residents. To implement such a strategy is quite onerous and will require as a minimum:

- 60 minutes fire resistance compartmentation for bedrooms (including floors and ceilings) and all routes to the adjoining protected area, refuge or final exit;

- If 60 minutes fire compartmentation is not achievable in an existing building then an automatic fire suppression system should be installed (sprinklers);

- Any resident left in a bedroom during an evacuation must be accompanied by a carer throughout. This will have a big impact on staffing levels.

- To avoid undue distress and communication problems for a resident, the fire alarm volume can be reduced within the bedroom to 45dBA (as opposed to 75dBA elsewhere).

- Communication procedures should be implemented to let the resident and carer know what is happening.

- It is still necessary to have an evacuation plan should this prove to be necessary.

- High standards of management, pre-planning and staff training are needed to implement this strategy successfully.
Fire and Rescue Services have encountered premises where a “stay-put” policy has been implemented inappropriately:

- Mainly for the convenience of management;

- In the mistaken belief that it will be easier to leave people in their rooms;

- Without some or all of the above requirements in place.

This cannot be condoned and enforcement action may need to be taken.
CHAPTER 6

Dangerous Conditions
Dangerous Conditions

Fire and Rescue Service personnel may encounter dangerous fire safety conditions within premises at any time, on duty or off.

Dangerous conditions can be described as a set of conditions or circumstances in a premises or building that present a serious risk to relevant persons in the event of fire, either immediately or imminently.

Personnel will encounter many differing levels of non-compliance with fire safety law, and different levels of risk, so it is important to emphasise that the term “dangerous conditions” in this context are those more extreme circumstances where people’s lives are self-evidently and demonstrably at risk.

Examples of dangerous conditions could include:

- Faulty or inadequate fire alarm or escape lighting system, especially within premises providing sleeping accommodation;
- Obstructed or blocked fire escape routes;
- Locked or blocked fire exits;
- Serious overcrowding;
- Excessive travel distances;
- Defective fire compartmentation, especially protection to means of escape staircases and protected routes;
- The presence of ignition sources not consistent with, or appropriate for the risk;
- Excessively high fire load and/or potential for very rapid fire spread;
- Unsuitability of the premises for the use to which it is being put;
- Etc.
A badly blocked fire exit

An exit chained and padlocked shut. Retail store open to public. High fire loading

Walls doors and ceilings covered with flammable upholstery foam and green carpet to improvise a sound studio.

Very long travel distances from upper floors which served accommodation, narrow and badly lit escape route, very high fire loading and potential for rapid fire spread. No fire alarm or detection.
If you have concern that people could be seriously injured or killed in a premises should a fire break out, then it is likely that dangerous conditions exist and you must act.

The UK Fire and Rescue Service maintains round-the-clock fire safety support to the public and front line FRS personnel. Any reported allegation or suspicion of dangerous conditions will result in a specialist Protection Officer being despatched to investigate. All fire and rescue services will have their own policies and procedures to deal with such reports.

Acting as the agent of the Fire & Rescue Authority, these specialist officers are empowered under the Regulatory Reform (Fire Safety) Order 2005 to investigate, and if necessary act, to stop lives being put at risk.

Article 31 of the FSO empowers the Fire & Rescue Authority to issue Prohibition Notices. A Prohibition Notice can be served on any premises covered by the FSO.

If the enforcing authority is of the opinion that the use of the premises involves, or will involve a serious risk to relevant persons, it may serve on the Responsible Person a Prohibition Notice.

This Notice:

- Must state the Fire Authorities opinion as to the risk;
- Must specify the matters that give rise to that opinion;
- Must direct that the use of all or part of the premises is prohibited or restricted until the specified matters have be remedied;
- May include directions as to how the situation may be remedied (giving choices if appropriate).
If there is no person to serve the Notice on, it may be firmly attached to the premises by whatever means are reasonable.

A Prohibition or Restriction Notice takes effect immediately it is served. It is a criminal offence for any person to fail to comply with any prohibition or restriction imposed by a Notice.

Whilst a person may appeal against a Prohibition Notice, it stays in full effect until such time as the Court decides the outcome of the appeal, or the enforcing authority withdraws it (e.g. because the fire risk problem has been resolved).
CHAPTER 7

Passive & Active Fire Precautions
Passive Fire Precautions

As the name suggests, passive fire precautions are fairly inert fire safety building elements integral to the fabric of the structure. These inanimate features are designed to play a key role in fire stability, fire compartmentation, helping to contain or control a fire, and contribute to means of escape.

Examples of passive fire precautions include:

- Fire resisting walls, floors & compartmentation;
- Smoke channelling down-stands;
- Fire stopping materials;
- Simple, manually operated fire doors;
- Fire exit signs.

The defining characteristic of passive fire precautions is that they will perform their designed function under fire emergency conditions with nothing else being required to make them work.
Active Fire Precautions

Active fire precautions are an increasingly common feature of modern buildings. They will also help to contain or control a fire and contribute to means of escape, but active precautions are usually triggered or powered in some way and are brought into effect either manually or automatically when required.

Examples of Active fire precautions include:

- Fire alarms & detection;
- Emergency lighting;
- Sprinklers;
- Smoke control systems;
- Fixed fire extinguishing installations;
- Controlled descent fire shutters;
- Pressurisation of staircases;
- Automatic fire ventilation systems;
- Fire door automatic hold open devices.

The defining characteristic of active fire precautions is that they require to be triggered or switched on in some way, to perform their designed function in a fire emergency.

There are many fire safety features within buildings which have both active and passive elements. The broad definitions given in this handbook are usually sufficient. There is no benefit in becoming involved in semantic arguments as to how to best define any particular piece of equipment or feature.
Half of the building shown below was saved by a combination of passive and active fire precautions which aided firefighting strategy and tactics.

A 60 minute “passive” fire resisting wall incorporating “active” fire resisting drop-down roller shutters separates the two halves of the building. To see the effect of these shutters, please turn to page 112 for interior photographs.

A Colt FM1 Fire Curtain shown half deployed.

The curtain stays within its housing until it is either tested or activated by the fire alarm and detection system.

Fire curtains of this type can have different fire resistance ratings, and this model is available in 60 or 120 minutes fire integrity.

*Photo courtesy of and © Colt International Ltd.*
CHAPTER 8

Emergency Lighting
Protection Handbook

What is Emergency Lighting?

Emergency lighting is in addition to a premises normal lighting system. It has its own power supply, and is designed to switch on in the event of power failure to the normal lighting.

Some premises have other supplementary lighting systems such as:

*Emergency Escape Lighting* – part of an emergency lighting system that provides illumination for the safety of people leaving a location or attempting to terminate a potentially dangerous process before doing so.

*Standby Lighting* – A system allowing most work and activities to continue substantially unchanged.

Emergency lighting is provided:

**To secure the means of escape.**

If escape routes in a building are plunged into darkness then people will not be able to see escape direction signs, their way to the exits, locate the fire alarm call points, or may stumble along the route and down staircases. In a fire emergency, escape may become impossible if the person becomes injured or lost.
To help find firefighting equipment

Strategically placed luminaires will ensure that fire alarm call points and firefighting equipment can be seen and used.

To assist fire-fighting and rescue

Emergency lighting systems have an extended operating duration, beyond the normal target fire evacuation times, for premises, in recognition that perhaps not all persons will have made their escape and may need additional assistance. Such lighting may also assist fire-fighting personnel who will have to make their way into the building to affect rescues and fight the fire.

As a legislative requirement.

Article 14 of the Regulatory Reform (Fire Safety) Order 2005 states that “where necessary”:

“emergency routes and exits requiring illumination must be provided with emergency lighting of adequate intensity in the case of failure of their normal lighting.”

The Order does not specify exactly how this should be achieved. It is accepted custom and practice that escape lighting systems are fitted. Nowhere will it say that an emergency lighting system conforming to BS EN standards must be fitted.
Some premises rely on “borrowed light” from external local authority street lighting to help illuminate escape routes. This may be acceptable providing that:

- The necessary lighting levels are achieved along the escape routes;
- The lights will be on when the premises is occupied during the hours of darkness.

For environmental reasons and in the interests of financial savings, some Local Authorities are cutting back the operating hours of street lights. This may have a detrimental impact on the means of escape for a premises relying on such lighting.

**System duration & type**

The use of the building will decide which standard needs to be specified. It should be normally possible to complete an orderly evacuation of most premises in less than one hour. However in an emergency, evacuation times may be increased, which results in escape lighting systems being required to operate for longer than the absolute minimum time required for an ideal evacuation of the premises.

For premises providing sleeping accommodation, and non-residential premises used for recreation, a 3hr duration emergency lighting system will be required. Non-residential premises used for treatment or care, offices, shopping malls, art galleries, etc., will usually only require a 1hr duration system.

Non-Maintained escape lighting is where the luminaires will be lit on failure of the normal lighting supply. Maintained escape lighting is where all luminaires are lit at all times.
Alternative emergency lighting provision

For small premises of low/medium risk with simple layouts, escape lighting may be provided by:

- Hand Torches
- Light Sticks

The advantages of these simple and alternative means of providing escape lighting are that they are low cost and easily provided. Disadvantages include the facts that torches can be removed, batteries may be flat, someone is required to operate it and they may be hampered from doing anything else.

Photoluminescence.

Photoluminescent products are increasingly used to illuminate escape signs and provide way-finding escape markings. Most of these products only require to be charged by natural or artificial light for a relatively short period of time and then will glow brightly for four or more hours. In some premises sufficient luminescent products have been used to eliminate the need for conventional powered escape lighting.
Radioluminescent signs

This type of sign is not so common, but nonetheless may still be encountered.

Requiring no power supply, light is constantly emitted from Tritium* filled glass tubes which are internally coated with Phosphor. They have a life span of up to 20 years and are deemed to be radioactively safe unless broken or damaged.

Under the Ionising Radiations Regulations 1999, Certificate of Approval (Health and Safety Executive) the radioactive emissions from such signs should have a dose rate at 0.1m from any accessible surface of less than 1 µSv** per hour. This equipment must be disposed of correctly at end of life.

* Tritium – Beta emitting radioactive isotope gas.

** µSv = micro sieverts – SI unit used to measure the biological effects of radiation.
**Emergency Lighting Components**

**Power supplies**

The emergency lighting system will take its power initially from the normal lighting or power (ring main) supply which will be used to trickle charge a battery back-up system.

The battery(s) being trickle charged will be either:

- **A Central Battery System**

  The battery bank will be located within the premises and may consist of dry cells or lead acid batteries, which will serve all the “slave” luminaires in the system. These types of systems are increasingly being replaced with self-contained emergency luminaire systems.

- **Within self-contained lighting units.**

  These self-contained lighting units have their own internal rechargeable batteries and a relay which switches the light on in the event of power failure.
Many of these units will have individual test switches either on the unit or more commonly at a suitable adjacent location. Operation of the switch will cut off the electrical supply and should cause the unit to switch to battery supply. It should be noted that the rechargeable batteries have limited serviceable lives (approx. 5 to 6 years).

These units normally have an indicator light (often red neon) which shows that the unit is powered. If this indicator light is not showing, it indicates some fault with the unit which should be investigated.

Standby generators

As an alternative to battery systems, some premises use stand-by generators. These are usually found in larger premises and are often set up to provide an emergency power supply to keep the premises operating normally in the event of a power failure, as well as supplying escape lighting in a fire emergency.

The diesel, petrol or gas fuelled generator will be located in a dedicated plant room and should be capable of running up to the required output within 5 to 15 seconds.

Wiring

The type of wiring used will depend on whether the luminaires have their own batteries or are powered from some remote source such as a central battery or generator.

Wiring to self-contained lighting units does not need any special consideration other than conforming to the IEE Wiring Regulations.
Wiring to slave lighting units needs special consideration and should either possess inherent fire resistance or be provided with additional protection. All such wiring should be suitably identified as well as being segregated from other wiring.

Luminaires

Luminaires may be easily identifiable units, or may be difficult to identify conventional “dual purpose” lighting units. Luminaires should be mounted as low as possible, but ideally at least 2m above floor level. It is better to have a larger number of low powered lights than few high powered lights.

Lighting levels are measured using an SI unit called Lux. There are many influencing factors which make accurate comparison difficult, but:

- A bright sunny day in summertime in the UK might have light levels in the region of 80,000 to 100,000 Lux.

- Full moonlight on a clear night will be in the region of 1 to 2 Lux.
Any minimum specified light level must be maintained for the duration of the system. Most systems start brighter, but then fade as batteries are depleted.

Escape lighting levels should be not less than:

1 Lux along the centre line of a defined escape route up to 2m in width. Until recently, the minimum was 0.2 Lux along permanently unobstructed escape routes.

Defined escape routes are places such as corridors, or where people have recognisable and unobstructed routes to follow.

0.5 Lux at the floor level of room larger than 60m² or those identified in the risk assessment as needing emergency lighting.

15 Lux is the minimum for kitchens and high risk task areas (Control rooms, dangerous plant, production lines, etc.). This should allow for proper shut down and safe evacuation of occupants.

Note: Fire and Rescue Service personnel are not required to measure lighting levels.
Management Responsibilities & Escape Lighting Testing.

It is statutory requirement under Article 17 of the FSO that the Responsible Person must ensure (where necessary) that any emergency lighting system installed is maintained in an efficient state, in efficient working order and in good repair.

Routine Testing

Because of the possibility of a failure of the normal lighting supply occurring shortly after a period of testing, or during the subsequent recharge period, all tests should be undertaken at a time of minimum risk.

Daily:

Visual examination of all luminaires, and check that any control or indicating panels are showing normal. Record any faults, and action taken to put them right, in logbook.

Monthly:

Brief test of each self-contained luminaire and internally lit sign by simulating failure of the supply to the normal lighting.

Brief test of central battery system by simulating failure of the supply to the normal lighting and check each slave luminaire/sign is lit.

Test of automatic start generator by simulating a failure of the supply to the normal lighting and checking that it starts and each luminaire/sign is lit.
At the end of each test, ensure that power supplies are returned to normal and all systems appear to be functioning properly. Top up any fuel/oil levels on generators as necessary. Record results, defects and remedial actions in logbook.

**Annually**

As per the monthly test, but run for the full duration of the system.
Emergency Lighting Location

Example of System Design

© Courtesy of Cooper Lighting Ltd
Locate luminaires at points of emphasis on escape route:

a = at each exit door  
b = to illuminate exit and safety signs  
c = near call points (some covered by a)  
d = near each staircase  
e = change of direction (some covered by b)  
f = near firefighting equipment (some covered by a)  
g = change of floor level  
h = near intersection of escape routes  
i = outside final exits  
j = near first aid points

Other areas that may require emergency lighting:

Lift cars  
Toilet (above 8m² floor area)  
Escalators and moving walkways  
Control/Plant/Motor rooms  
Anti-Panic lighting for open areas  
High risk areas  
External escape routes

(From Emergency Lighting Design Guide, courtesy of Cooper Lighting Ltd.)
CHAPTER 9

Fire Alarms & Detection
The Purpose of Fire Alarms

To save life

One of the most important factors in saving life when a fire occurs is to warn all the occupants of danger. This is the first consideration for any fire safety scheme. In countless incidents, a delay in raising the alarm has resulted in the loss of life.

The selection of any alarm specification will be dependent on the nature of the premises occupancy as well as the design and construction of the premises itself.

As a compensatory feature

In some premises it may prove difficult to arrive at a satisfactory conventional means of escape scheme. This is particularly common in existing buildings, or those which are undergoing structural alterations, or being adapted for a different use.

A fire alarm may be installed to a higher level specification than would normally be required, so as to compensate for some structural or design feature in a premises, which would otherwise reduce the effectiveness of the MOE scheme. It should be noted that not all MOE deficiencies can be compensated for in this way.

As part of an engineered solution

Many buildings of modern innovative design will rely on a package of active and passive fire precaution measures to achieve a safe means of escape scheme. Fire alarm systems are often the initiating trigger for the activation of fire engineering installations.
Fire detectors and alarms are therefore an important part of most design packages and any failure of these systems could leave the premises in a very unsafe condition.

To protect property

Owners and occupiers will often install higher specification fire alarm/detection systems than would normally be required, in order to protect high value property or high risk processes. However, the majority of owners/occupiers will be satisfied with the minimum "life safety" fire alarm provision recommended by the Fire Authority.

Legislative requirements

Article 13 of the Regulatory Reform (Fire Safety) Order 2005 requires a risk assessed approach to the installation of means of giving warning to relevant persons in the event of a fire. Legislation does not specify exactly how that warning should be given, or demand that fire warning system conforming to BS 5839 must be fitted.

In the U.K. it is the British/European Standard that has been accepted by the Government, Local Authorities, Fire Authorities, Insurers and numerous Codes of Practice and Guides, as being the most appropriate and efficient method of providing warning for most premises.
**Design Standard & Types of Alarm**

**Design standard**

*British Standard 5839:* This is the principle UK standard for fire detection and fire alarm systems in buildings. It describes alarm types, design and installation criteria and considerations, along with recommendations for servicing and maintenance requirements:

- *Code of Practice for system design, installation, commissioning and maintenance. BS 5839 - Part 1:*

- *Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings. BS 5839 - Part 6*

**Types of fire alarm**

The three main categories of fire alarms are:

- *Manual*

- *Manual/Electric*

- *Manual/Electric & Detection*

**Manual fire alarms**

- Hand bells

- Whistles
• Hand strikers
• Rotary gongs
• Hand operated
• Sirens
• Public Address systems
• Shouting!

Manual fire alarms are cheaply and quickly provided. There are problems such as; audibility over a large area, the alarms may be mislaid when needed, and a person has to be present to operate it. For all these reasons, manual alarms systems are only provided in smaller premises with simple layouts.

Public address systems are often found in larger premises, public access buildings and such places as sports stadia. They may also be present in premises for normal day to day use. These “everyday” systems are best avoided for emergency use unless specifically designed to include use as a fire alarm, i.e. conforming to BS 5839, Part 8. When compared to fire bells or sirens, voice alarms have been shown to be particularly effective at initiating a swifter evacuation response from occupants.

Manual / electric fire alarms

Manual/Electric systems are probably the most common. They are initiated manually but will operate electrically, having the advantage of being a fixed system, having good audibility and not detaining the person who initiates the alarm.
These fire alarm systems comprise of call points, a control and indicator panel and electric sounders.

This is referred to as a Category M System. Category M systems are not normally accepted for sleeping risks.

The following floor plans show a fictitious premises to illustrate the different types of alarm categories.

Category M

Category M systems comprise of:

- Break glass call points and sounders, a fire alarm control and indicating panel, usually located near the main entrance. This location should have good lighting levels and not be too noisy;
• Fire alarm call points near to each exit so that no person has to travel more than 45m along the escape routes to reach one;

• Fire alarm sounders located to achieve a general alarm audibility level of:
  
  ▪ 65 dB(A) or;
  
  ▪ 60 dB(A) in small enclosed spaces (Even lower sound levels may be used in specific circumstances);
  
  ▪ 75 dB(A) within sleeping rooms to rouse sleeping occupants;
  
  ▪ Sound levels must not be excessive. It is better to have several quieter sounders rather than fewer louder sounders;
  
  ▪ Avoid having loud sounders close to the fire alarm panel.
Life safety systems

Category L5

This category has the same specification as a category M, but will have detection in certain locations to satisfy certain specific fire safety objectives (determined by fire risk assessment), e.g. access room to inner room; to compensate from some departure from normal guidance; to trigger an automatic fire protection system, etc.

$L5 = M + $ Detection provided to fix fire safety problems in specific areas
**Category L4**

This category will have the same specification as Category M, plus L5 (if this has been required), plus:

- Detectors in escape routes, such as circulation areas, corridors and stairways.

\[ \text{L4} = \text{M} + \text{L5}. \] Detection now provided in staircases and corridors.
Category L3

This category will have the same specification as Category M, plus L5, plus L4, plus:

- Detection in rooms directly off circulation areas and escape routes.

\[ L3 = M + L5 + L4. \] Detection now provided in rooms off means of escape.

L3 may be found in school and student residencies, family group homes (especially refuges and vulnerable groups), although L2 is normally advised for sleeping risk premises.
**Category L2**

This category will have the same specification as Category M, plus L5, plus L4, plus L3, plus:

- Detectors in high risk rooms and areas of higher fire hazard (boiler rooms, plant rooms, large lounges, kitchens, etc.).

\[L2 = M + L5 + L4 + L3\]. Detection now provided in other vulnerable/high risk rooms.

L2 is the suggested standard of automatic fire detection for most sleeping risk premises.
Protection Handbook

**Category L1**

This category will have the same specification as Category M, plus L5, plus L4, plus L3, plus L2, plus:

- Detectors in every room, duct, void, roof space, etc. Detectors installed everywhere!

\[ L1 = M + L5 + L4 + L3 + L2 \]. Detection now provided throughout the premises (ducts, voids, cupboards, roof space, etc.).
Property protection systems P1 & P2

P1 is the highest specification for this type, giving total coverage, whilst P2 gives coverage to selected areas.

They are designed to protect high value property or high risk processes and plant.

Property protection installations often employ specialist detection methods, may provide a rapid response and are frequently linked to automatic fire suppression systems.

Such systems are often more sophisticated and extensive than "life" systems. Some systems can be industrial in their approach, whilst others can be very discrete and hidden to preserve aesthetics and minimise impact.

Screen from computer monitored video fire & smoke detection system.
Basic Design and Operation Principles

Power supplies

- Normal electricity supply.
- Standby power supply - trickle charges batteries.
- Standby generators (Auto).

Power supplies should be labelled "Fire Alarms: Do Not Switch Off" and its isolating switch secured from unauthorised operation.

Standby batteries should be capable of providing a full 24 hours of cover, plus being able to operate the alarm for a further 30 minutes in the event of a failure of the main supply or a charging fault occurring.

Standby generators are usually reserved for larger premises and buildings, where risk, or business continuity dictates the need.

Wiring

There are three main considerations:

- Physical Protection;
- Monitoring;
- Inducing False Alarms;
Physical protection

Wiring serving power supplies, control and indicating panels and sounders must be either protected from the effects of fire or be inherently fire resisting, as these components are required to operate for prolonged periods during a fire. (This requirement is not critical for wiring serving other components).

All wiring should be protected from normal mechanical and corrosive damage. This can be achieved by careful location, putting it into protective conduit or burying it within walls etc.

Monitoring

The wiring should be constantly monitored for circuit failure or breakdown. Any fault identified should trigger a fault alarm at the indicator panel.
Induced False Alarms

Wiring for fire alarms systems should be segregated or screened from wiring serving other circuits.

Failure to do this adequately may result in alarm wiring acquiring an induced current flow when the other circuit is energised. This induced current flow could generate a false fire alarm signal.

Radio systems

To reduce the cost and difficulties associated with hard wiring in components of a fire alarm, manufacturers have developed systems where the components communicate with each other using radio signals.

Control and Indicator Panels

This is the” brain” of the system with a twin function suggested by its name. It should have lockable controls and should give audible and visual warning of both faults and power failure. It should be located on the ground floor, or in an area of common usage, or in a dedicated control room.

It should also be easily accessible to the Fire Service, have suitable levels of illumination and sound levels in the vicinity should not be so loud as to mask audible fault or indicator warning, or interfere with communications.
Repeater Panels

In larger premises it is common to provide an easily accessible repeater control and indicator panel which will mimic the master panel.

Call points

Manual call points should be located: -

- On exit routes
- Floor landings
- Adjacent to all final exits
- Max 45m travel to reach nearest call point
- 1.4 m above floor

Automatic detection

There are many different types of detectors and detection methods available. An increasingly common feature of modern detectors is to combine one or more detection methods into one detector and use micro-processors to help analyse signals and reduce false alarms. This handbook will restrict itself to a simple explanation of the most common types likely to be encountered.
Ionisation

These detectors contain a very small amount of a radioactive isotope Americium 241 which is primarily an Alpha emitter. The quantity and activity of these sources is extremely low, usually in the region of 30 to 40 kBq [kilo Becquerel]. Despite this, many people are worried about radiation sources.

The following information relating to domestic ionisation chamber smoke detectors (ICSD) may put things into perspective:

"The source construction and activity of the americium-241 source in an ICSD minimises the radiation doses to persons arising from uncontrolled disposal. The NRPB calculations on unrestricted disposal of ICSDs have shown that the potential radiation doses to persons living close to a disposal site are extremely low, less than 1 microsievert per year. It follows that the disposal of modern ICSDs in domestic waste is a straightforward and cost effective method of disposal, and an Exemption Order 1 issued by Her Majesty’s Inspectorate of Pollution (now part of the Environment Agency) permits the disposal of ICSDs by this pathway."


http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/InformationSheets/info_IcSDs/
Accessed November 2013

It must be noted that these judgements are made on the basis that the ionisation chamber of the detector is intact. Ionisation chambers must not be broken open. It is also worth noting that smoke detectors will come under the Waste Electronic and Electrical Equipment Regulations 2006 (WEEE Regs.) and should therefore be recycled. The manufacturer or the local authority should be able to advise on how this can be achieved.
Simplified diagram of an ionisation type smoke detector in non-fire and fire condition.

The radioactive source ionises the air within the chamber, giving its atoms and molecules an electric charge, which allows a small current to flow between two electrodes (normally air would act as an insulator and no charge could flow). When the products of combustion enter the chamber they can attach themselves to the charged ions (electrically charged atoms and molecules), interfering with the current flow causing the current to drop, triggering the alarm.

Because these detectors work on the scale of ions (far too small to see with the naked eye) they are particularly good at responding to the invisible products of combustion. Such detectors will be triggered by pre-fire products, such as the over-heating of cooking oil in a frying pan, where the absence of visible smoke will often result in an optical detector remaining silent.
Optical

There are different types of optical smoke detectors available. As the name suggests, they work best with smoke that is visible. Any fire that produces lots of visible smoke, such as smouldering foam filled furniture, plastics, etc. is likely to trigger this type of alarm quickly. Conversely, any fire that burns quickly, with little visible smoke, may not trigger this type of alarm for some considerable time.

Simplified diagram of internal “light scatter” type of optical smoke detector in non-fire and fire condition.

Heat

Heat detectors are divided into three main groups:

- Fixed temperature element
- Rate of rise of temperature element
- Combined rate of rise + fixed temperature
Modern heat detectors usually combine rate of rise and fixed temperature functions as this provides the most reliable detector in fire situations where heat levels may slowly increase, thereby not triggering the rate of rise mechanism. The technology used to sense the temperature rise may vary, but an electronic heat sensing device called a thermistor is common.

Some heat detectors (particularly older types) may contain one or more bi-metallic strips. These strips will expand and bend when subjected to heat, and this action can be used to make an electrical contact, thereby triggering the alarm.

As a general rule of thumb, heat detectors require the flames from a fire to reach approximately one-third of the distance to the ceiling before they will operate.

Heat detectors (with their slower response times) are usually reserved for use in areas where smoking, cooking or other fumes may be encountered.
**Intelligent addressable analogue detectors**

A simple and basic fire alarm relies on fire detectors which are in essence nothing more than sophisticated on/off switches.

This simplistic approach can bring problems and to address some of these, manufacturers and specifiers are turning to intelligent addressable analogue technology. These types of systems are now very common.

In these systems each detector has its own electronic address. Its "intelligence" is derived from containing one or more detection methods and may have its own "fuzzy logic" computer chip, which is programmed to analyse and discriminate between common false alarm signals and fire signals. (on some systems this processing may occur within the control panel).

Each detector will continuously send an analogue signal back to the fire control panel to inform it of its condition and status. These signals will be automatically monitored, analysed, and adjacent detectors interrogated to determine if early fire conditions are becoming evident. This affords an opportunity for a pre-alarm to be raised and an investigation to be carried out.

This constant monitoring will also allow the control panel to make adjustments and compensate for deterioration detector performance which inevitably occurs over time.
Using multi-sensor technology allows detectors to outperform the typical reaction characteristics associated with different single sensor types and can greatly reduce false alarms.

**Detector siting**

Detectors are usually sited so that no point on the ceiling is more than 7.5 m from any smoke detector, or

From A Guide to BS 5839 - © Hochiki Europe (UK) Ltd
No point on the ceiling is more than 5.3m from any heat detector.

Other types of detectors will be encountered such as:

**Beam detectors**

These detectors use light obscuration of either a projected or reflected beam to detect fire. These are useful for detecting fire in large spaces.

Fireray reflective beam smoke detector.

© Fire Fighting Enterprises Ltd
Flame detectors

These detectors are used for ultra-fast fire detection to protect high risk plant, installations and manufacturing.

UV & IR Flame scanners/detectors. Capable of providing ultra-fast fire detection.

Aspirating smoke detection

Aspirating smoke detectors use an air sampling process to detect fire at its very early stages. A popular and common system is Very Early Smoke Detecting Apparatus (VESDA).

As the name suggests, these systems are capable of detecting airborne product of pyrolysis at very low levels (parts per million), often at the overheating stage and often before any sign of visible combustion takes place.

These systems can be used to protect plant, machinery and processes, and are also often used to protect heritage risks because of the discrete way in which it can be installed.

An aspirating smoke detection system showing the main aspirating panel, pipe work and sampling points
Fire alarm zones

Fire alarms in premises are normally divided into zones dictated by:

- Maximum floor area limit of $2000m^2$
- Maximum search distance of 60m
- Fire compartmentation
- Occupancies
Search distances

Search distances can be greatly reduced by the installation of remote indicator lights for the detector heads.

![Remote indicator light showing activation within room](image)

From A Guide to BS 5839 - © Hochiki Europe (UK) Ltd

Alarm sounders

Minimum of two sounders (the BS allows this on the basis that if one sounder should fail there will still be another to raise the alarm.) All should have same distinct sound.
Sound levels required - 65dBA or 5dBA louder than background.

Sleeping areas 75dBA at the bed head. There is discretion for reduced audibility levels within rooms subjected to delayed evacuation procedures in residential care premises.

If high levels of background noise exist (e.g. industrial premises and the like) then the sounders should be supplemented by visual warning.

Staff alarms

In large assembly premises it is normal for the operation of a call point to initiate an alert to management and staff only, prior to a full alert within an agreed period of time delay.

Staged alarms

Large premises may have a staged alarm system, with evacuation signals sent to the fire floor and other specified floors and alert signals to all others. The staging of fire alarms and evacuation is particularly common in high rise buildings.
Voice alarms

There is an increasing trend toward fire alarms using pre-recorded or live voice messages. They are particularly useful in public access buildings and have been shown to dramatically reduce "start-up" times.

Calling the fire and rescue service

Summoning the Fire Service may be via: -

- 999 (or 112)
- Direct connection to Fire Service
- Auto-dialler - When a fire alarm activates this device automatically dials 999 and communicates a repeated pre-recorded message. They are no longer considered acceptable because:
  - the call could be lost in the Publically Switched Telephone Network (PSTN);
• there is no permanent link therefore the line cannot be monitored for faults;

• the system cannot be tested using the 999 system and on occasions the message has been unintelligible.

Remote monitoring station

Owner/occupiers can pay a security company to remotely monitor their premises fire alarm so they can call the fire service on their behalf when it activates.
Management Responsibilities & Fire Alarm Testing

The need to maintain any alarm and detection system installed is a requirement of the Regulatory Reform (Fire Safety) Order 2005.

A précis of the maintenance requirements specified within British Standard 5839, Part 1:2002 + A2:2008, Section 6, is given below, along with some optional good practice recommendations. Please refer to the full standard for comprehensive guidance. (Note: other European or international equivalent standards may need to be referred to, if such a system is installed).

Daily (optional good practice)

Visual inspection by the occupier (suitably trained and competent to do so) to check:

- Panel Indicator lights are normal;

- Test line if connected to the fire service or a remote monitoring station (Note: the facility to undertake a daily test will be dependent on the contract and service level agreement between the two parties).

- Any faults found must be recorded and acted upon.
Weekly

Weekly test of the fire alarm by the occupier (*suitably trained and competent to do so*), preferably at same time every week, and giving prior warning to people in the building, asking them to report any problems they experience with the alarm (e.g. sounders not working, etc.):

- If connected to the Fire & Rescue Service, or a monitoring station, ensure they are notified and aware prior to the test commencing, and immediately after its conclusion;

- Operate one call point to commence a test of the system, for approximately one minute (deliberately short duration because in the event of a real fire, the longer duration operation will alert occupants that it is not a test). Rotate the call point chosen so that all get tested over time;

- Test of voice alarm (if fitted);

- Record test, any defects and actions taken to remedy them in the premises log book.

Weekly optional good practice:

- Visual check of batteries;

- If system has printer, check paper/ribbon/ink to ensure at least two weeks supply;
Protection Handbook

Monthly (by user)

Monthly tests carried out by the occupier (*suitably trained and competent to do so*).

If the premises is fitted with automatic start generator:

- Test generator by simulating failure of the normal power supply and run for 1 hour. Check fuel, oil, water, etc;
- If vented batteries are used as a standby power supply, a visual inspection should be made to ensure they are in good condition.
- Record test, defects and actions taken to remedy them in log book.

As Dictated by Risk Assessment, or Minimum Six Monthly

Tests carried out by competent person (usually an external specialist contractor, e.g. fire alarm maintenance company):

- Examine log book and take appropriate action as necessary;
- Visual inspection of the premises to check for structural changes or other problems;
- Standby and other batteries and connections should be checked in accordance with manufacturer’s instructions;
- Controls and visual indicators (*including fault indicators*) should be checked for correct operation and the alarm functions of the control panel checked by operation of at least one detector or call point in each zone. Any links to a remote monitoring station should be tested;
Check of any printers and consumables;

Any further checks/tests recommended by the manufacturer.

Annually

Tests carried out by a competent person (usually an external specialist contractor, e.g. a fire alarm maintenance company).

- All the six monthly tests previously described;

- Examination and functional testing of every detector head (all types, heat, optical, flame, aspirating, etc.) and every call point;

- Visual inspection of all cables, fittings and equipment;

- All defects and actions taken to remedy them should be recorded in the premises log book.

On satisfactory completion a certificate of testing should be given to the Responsible Person for the premises.

When visiting or checking premises, remember that it is not the responsibility of the Fire & Rescue Service to test alarm systems, or to give detailed advice on maintenance. Any invitation to do so should be politely declined and the person advised to seek the services of a competent fire alarm company or engineer.
Missing or Defective Fire Alarm and Detection Systems.

Almost every fire alarm and detection is installed for life or property protection purposes. Failure to install such a system where it would normally be required, or premises where the system has become defective, may create dangerous conditions.

A fire alarm and detection system is essential in premises where:

- There is a sleeping risk;

- The alarm has been installed as a compensatory feature for some deficiency in the premises means of escape (e.g. extended travel distances, dead end corridors, etc.);

- The detection and alarm system is an integral part of a fire engineered fire safety solution (e.g. a shopping mall);

- There is a high fire/life risk and the alarm and detection system is vital to means of escape.

If the fire alarm is missing or defective within the premises described above, then urgent advice must be obtained. If there is some doubt or uncertainty about whether there is a need for a fire alarm and detection system, then advice must be sought.
CHAPTER 10

Fire Fighting Equipment
The Requirement for Fire Fighting Equipment (FFE)

Article 13 of the Regulatory Reform (Fire Safety) Order 2005 says:

Where necessary (whether due to the features of the premises, the activity carried on there, any hazard present or any other relevant circumstances) in order to safeguard the safety of relevant persons, the Responsible Person must ensure that—

(a) the premises are, to the extent that it is appropriate, equipped with appropriate firefighting equipment and with fire detectors and alarms; and

(b) any non-automatic fire-fighting equipment so provided is easily accessible, simple to use and indicated by signs.

Key words to note in this extract are “Where necessary”. The use of these words indicates that a fire risk assessment is used to determine what is necessary. This means that rather than a mandatory legal requirement, it becomes a risk assessed legal requirement whether to have firefighting equipment (FFE) or not.

Some organisations and businesses have reviewed their provision of FFE and decided that it is not necessary. A frequently encountered reason given is that firefighting is too dangerous and staff should evacuate rather than be put at risk. Other reasons may include the fact that staff training requirements are often perceived as being onerous. By removing extinguishers, the cost of providing and maintaining extinguishers, along with staff training can be saved.

Most business overcome these “difficulties” by providing basic fire safety training to all staff, but reserving training in practical extinguisher selection and use for their team of fire wardens (marshals) as nominated under article 15 (1)(b) of the FSO.
For some premises the decision to remove extinguishers may be justified, but for the majority, such a fire risk assessment is unlikely to be appropriate. From the FRA’s perspective, if it is believed that the removal of FFE could place relevant persons at risk from fire, then the fire risk assessment should be challenged. This task will be the responsibility of a specialist fire Protection officer.

Apart from the legal reason outlined above, understanding why FFE should be provided is important when conducting a fire risk assessment.

First aid fire fighting

Extinguishers provide a capability to tackle a small fire in its early stages of development. They are not provided to tackle rapidly growing or established fires. If a member of staff is uncertain about the severity of the fire and their safety, they are under no compulsion to attempt to fight it.

Mitigate the effects of fire

The provision of FFE may be regarded as helping to mitigate the effects of a fire because having the capability to tackling the fire early, and hopefully extinguishing it, will stop it growing and spreading, reducing damage, and aiding a speedy recovery. (See Article 4 of the FSO – general fire precautions).

Securing the means of escape?

A commonly repeated assertion is that FFE is provided so that people can make a last ditch attempt to fire-fight their way out of a building. This is not the case. If a premises means of escape scheme and fire risk assessment requires people to be able to use an extinguisher to escape, things have gone badly wrong!
However, the appropriate use of an extinguisher may extinguish a fire and make evacuation unnecessary, or it may “buy time” to allow others to evacuate. This could be particularly appropriate in the health and residential care sectors.

Other factors

There has been growing unease and concern about the trend for some fire risk assessors to decide that the provision of FFE is not necessary, and many fire risk assessments have been questioned with regard to their suitability and sufficiency in relation to this.

In 2003 the Fire Industry Association (FIA) published a report on their Survey Into Portable Fire Extinguishers And Their Use In The UK.

The survey was conducted over four months, analysing information and data from 2137 fires, compiled with the assistance of insurance and extinguisher maintenance companies. The survey revealed that 75% of fires (1637) were not reported to the fire and rescue service.

80% of fires were successfully dealt with using portable firefighting equipment.

Using this information, the survey estimates that the provision of firefighting equipment saves the economy approximately £500m annually, and could prevent 1630 people being injured and 24 people being killed.
British Standards for fire extinguishing equipment

There are several British Standards that deal with different aspects of portable firefighting equipment, such as design and construction, maintenance and testing, etc.

Some of the most frequent questions regarding what type of extinguishers to have and where to put them, are dealt with in BS 5306 Part 8.

This handbook will illustrate some of the requirements of these standards.
**Classification of Fire and Types of Extinguisher**

Classes of fire from BS EN 2:

<table>
<thead>
<tr>
<th>CLASS</th>
<th>Type</th>
<th>Extinguishing Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Solid/Carbonaceous</td>
<td>Water/Foam/AFFF</td>
</tr>
<tr>
<td>B</td>
<td>Liquids/Liquefiable solids</td>
<td>Foam/AFF/Dry Powder/Fire Blanket</td>
</tr>
<tr>
<td>C</td>
<td>Flammable gases</td>
<td>Dry Powder/ Inert Gases/Turn Off</td>
</tr>
<tr>
<td>D</td>
<td>Metals</td>
<td>Dry Salt/Sand/TEC/Cement</td>
</tr>
<tr>
<td>F</td>
<td>Fats &amp; Cooking Oils</td>
<td>Saponification types (wet chemical)</td>
</tr>
</tbody>
</table>

The use of Halon/BCF as firefighting media is now severely restricted and as a result, not usually encountered.

Powder extinguishers can cause a sudden reduction in visibility and impair breathing. Generally, they should not be specified for use indoors, unless mitigated by a health & safety risk assessment.

Class C – Flammable gases - The recommended first aid firefighting measure for flammable gases is to turn off the gas supply. To extinguish the flames without doing so has the potential to result in a gas explosion.

Class F - Foam extinguishers and fire blankets could be used on fat and cooking oil fires. However, because of the high auto ignition temperatures of cooking oils (340°C +), and the risk of the applied foam splashing the burning liquid out of its containment, conventional Class B foam extinguishers are not ideally suited to the task.

Fire blankets tend to work better on smaller fat/oil fires. An area greater than 0.4m² should be protected by a fixed extinguishing system.
Protection Handbook

Wet chemical fire extinguishers which work by saponification have been specially developed to deal with Class F fires. They usually have a longer application lance, slower and less forceful rate of application to reduce risk of splashing, and the extinguishing agent produced will react with the high temperature burning liquid to produce a thick soapy crust which cuts off atmospheric oxygen and smothers the fire.

Fires Involving Electrical Equipment

BS 5306 Part 8 refers to fires involving an electrical hazard. Electricity is a form of energy which can act as an ignition source. It does not burn. Fires which are commonly referred to as “electrical” actually involve the combustion of fuel, usually electrical insulation materials, or the body of the appliance or equipment itself. If the electrical source can be switched off and rendered safe then usually only a class A fire will remain.

| Electrical | Electrical equipment | CO²/Inert Gas/Dry Powder |

If the appliance or equipment remains “live” during a fire, there is a risk of electrocution, either from electricity being conducted back through the stream of fire-fighting media being applied, or along wetted surfaces.

Some water-based models with a spray type discharge have passed the dielectric test of BS EN 3. This does not necessarily mean that they can be used directly on fires involving electrical equipment but it will reduce the danger of conduction of electricity along the discharge stream. Electrical conduction along wetted and possibly contaminated surfaces may still occur. As a general rule only non-conductive extinguishing media should be specified for use on electrical equipment.
Extinguisher colour coding and marking

Extinguishers should be designed and manufactured to conform to BS EN 3-7. This standard includes the requirement for extinguishers to be predominantly red in colour with up to 10% of the extinguisher’s body being used to identify the extinguishing agent:

- **Red** = Water
- **Blue** = Dry powder
- **Cream** = Foam
- **Black** = CO₂
- **Yellow** = Wet chemical

To help overcome language barriers and ease use, extinguishers should be marked with icons to supplement operating instructions.
Extinguisher Rating and Siting

An extinguisher is rated for the size of fire that it should be able to extinguish. A “standard” fire is built, lit, and allowed to pre-burn for a set period of time. The extinguisher is rated according to how many metres of this test fire it is capable of extinguishing. To make allowances for the skill of the extinguisher operator a small deduction is made from the final result.

A conventional 9 litre water extinguisher will have a rating of 13A. This means that the extinguisher has been able to extinguish 1.3 metres of test fire.

Technological developments and improvements have resulted in some smaller extinguishers being given a 13A rating (i.e. the Chubb Hydrospray 3 litre water extinguisher).

Extinguishers may have an A rating, B rating, or both. This rating system provides a benchmark for specification and allows the customer to purchase the rated extinguisher of their choice.

To determine Class A extinguisher requirements, the British Standard uses a simple formula:

Floor area (m$^2$) x 0.065 = A Rating

The British Standard specifies at least 2 extinguishers with a class A rating for any storey within a premises (any floor area less than or equal to 400m$^2$ should have a combined minimum total fire rating of 26A).
If the premises in question were a single story building of 40m x 40m (1600m²), the A rating required would be: 1600 x 0.065 = 104A

104A would be expressed as the minimum extinguisher requirement for the premises. To see how many extinguishers would be required, simply divide the A rating by 13 (this is the minimum size extinguisher usually supplied).

104A ÷ 13 = 8 extinguishers, each with a 13A rating

Siting extinguishers

Extinguishers should be sited to meet the maximum travel distances:

- Class A 30m
- Class B 10m
- Class C 30m
- Class D expert advice
- Class F 10m
Extinguishers should be hung on brackets so that the handle is at a suitable height, somewhere between 1 and 1.5 m from the floor, depending on the size of the extinguisher and capabilities of the users.

The environment within which the extinguisher is stored and used should also be taken into account when specifying or recommending extinguishers. Wet or damp conditions, corrosive atmospheres (salt laden air, fumes, etc.) or abnormally high or low temperatures may require special equipment provision.

Different fire risks have to be accommodated, but to avoid confusion and help potential operators, providing a multiplicity of different types of extinguishers with different operating methods should be avoided as far as possible.

FFE is often positioned so that it is clearly visible. Where this is not the case, additional signs may have to be provided. The provision of location signs may also help identify that an extinguisher has been removed from its position.

Extinguishers may also be clustered together to form recognisable Fire Points, where all relevant fire and evacuation equipment and information may be kept.
Class B - Flammable liquids and liquefiable solids

In deciding that FFE may be required for a Class B risk, the following facts have to be ascertained:

- Physical and chemical properties of the fuel;
- How is the fuel stored or used;
- Quantities likely to become involved;
- Proximity of other Class B fuel sources and likelihood of fire spread.

Depending on the physical and chemical properties of the flammable liquid, there may be the need to provide specialist foam, such as alcohol or solvent resistant foam.

For running fuel fires resulting from the ignition of a spillage of a flammable liquid, Dry Powder is recommended for a quick knock-down. This is because a blanket of applied foam is likely to break-up and allow re-ignition. Once the moving liquid has settled, foam can be applied to prevent ignition.

Current guidance recommends that a maximum of 50 litres of flammable liquid is stored in a workroom, in an approved bunded storage facility. Individual flammable liquid containers can vary in size, but for handling purposes, it is generally assumed that the maximum quantity of liquid that may be spilt will come from a container not exceeding 25 litres capacity.

To calculate the B rating required for a spill fire:

\[ 10 \times \text{Volume (litres)} = \text{B Rating} \]
If the risk exceeds 25 litres then the risk will require bunding. Bunding is where a form of containment is provided to capture any spill or leak. The bunding may be incorporated into the storage facility, or the flammable liquids may be stored within bund walls.

Just as Class A fire has an extinguisher rating system, so does Class B. The following table is an extract taken from Table 1 in BS 5306-8:2012.

<table>
<thead>
<tr>
<th>Maximum area of exposed Class B in m²</th>
<th>Min. quantity &amp; min. rating for each extinguisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14</td>
<td>1x 21B</td>
</tr>
<tr>
<td>0.23</td>
<td>1x 34B</td>
</tr>
<tr>
<td>0.37</td>
<td>1x 55B</td>
</tr>
<tr>
<td>0.47</td>
<td>1x 70B</td>
</tr>
<tr>
<td>0.59</td>
<td>1x 89B</td>
</tr>
</tbody>
</table>

The data used to underpin this table has been derived from test fires conducted in ideal conditions and extinguished by an experienced operator. It is recognised that this will not be the case in a real fire situation, so de-rating factors are applied according to the number and type of extinguishers to be used. These de-rating factors are incorporated into Table 1.

If there is a single flammable liquid risk it is relatively easy to use Table 1 above to determine the B Rating required. Where there is more than one source of flammable liquid the potential for fire to spread from one container or bund to another has to be taken into account.

In these circumstances risks are divided into:

- Separate risks more than 20m apart;
- Divided groups where containers are >2m but <20m apart;
- Undivided groups where containers are <2m apart.
To determine the B Rating required you must take the greatest of either:

- The surface area of the largest tank;
- The aggregate surface area of an undivided group of tanks, or;
- $\frac{1}{3}$ of the total aggregated areas of all the tanks in the divided and undivided groups.

This area would then be used in Table 1 to find the B rating.

It is a characteristic of flammable liquid fires that for quite modest risks, hand held portable firefighting equipment becomes ineffective and impractical. For larger risks, trolley mounted extinguishers or fixed installations are required.
Other Fire Fighting Equipment

Hose reels should conform to BS EN 671-1 and be installed to BS 5306-1.

The length of hose should be such that the nozzle can be taken into every room, and within 6m of every part of a room. Reels should have their own water supply and the smallest nozzle available should have a water flow rate of 12 l/min and a jet throw of 10m.

Note: Many hose reels are now being withdrawn from use and any request for advice regarding their use or removal should be referred to a specialist Protection Officer.

A conventional Class A water extinguisher will run-out when used and this can act as a prompt to the user to retreat if the firefighting attempt is proving to be unsuccessful. However, a hose reel will not run-out. Operators have to be made aware of this during their training as they may be tempted to stay too long fighting a fire they should be escaping from.

Fire Blankets should conform to BS EN 1869. Because of the injuries sustained by untrained people, fire blankets are not usually recommended for the home unless the users have been suitably trained. They tend to be more commonly installed in commercial premises where staff training is more formalised.
Fire Buckets can be a useful firefighting choice for smaller fire risks in simple premises. In addition to containing water, they can also be filled with dry sand if this is more appropriate for the risk being protected.

**Fire Fighting Equipment Maintenance**

Portable fire extinguishers should be maintained in accordance with BS 5306, Part 3, Code of Practice, Commissioning and Maintenance of Portable Fire Extinguishers.

This standard recommends a monthly visual inspection by the Responsible Person. In addition, the following maintenance intervals are recommended:

**Table 1 - Maintenance Intervals**

<table>
<thead>
<tr>
<th>Type of Extinguisher</th>
<th>Basic Service</th>
<th>Extended Service</th>
<th>Overhaul</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water &amp; water based</td>
<td>12 Monthly</td>
<td>Every 5 years</td>
<td>-</td>
</tr>
<tr>
<td>Powder</td>
<td>12 Monthly</td>
<td>Every 5 years</td>
<td>-</td>
</tr>
<tr>
<td>Powder – primary sealed¹</td>
<td>12 Monthly</td>
<td>Every 10 years</td>
<td>-</td>
</tr>
<tr>
<td>Halon²</td>
<td>12 Monthly</td>
<td>-</td>
<td>Every 10 years</td>
</tr>
<tr>
<td>CO₂</td>
<td>12 Monthly</td>
<td>-</td>
<td>Every 10 years</td>
</tr>
</tbody>
</table>

¹ Primary sealed stored pressure extinguishers are sealed units which should be returned to the manufacturer for recharging.

² Critical use extinguishers only in accordance with EC Regulation 1802:2002.
Each extinguisher should be marked with a record of its last test/examination. If stickers or labels are used, these must not be placed on top of each other, but adjacent, so that the history of maintenance and testing can be viewed. A record of testing and inspection should be made, preferably in a log book.

Defective extinguishers are potentially very dangerous because they may be incapable of extinguishing a fire, luring the unsuspecting operator into a more dangerous situation. Some defective or damaged extinguishers have been known to fail catastrophically when used, injuring the operator, or persons nearby.
CHAPTER 11

Fire Sprinklers
The History of Sprinklers

One of the most important principles of tackling any fire is early detection and extinguishment. It follows that any device or system that can automatically detect a fire and then control or extinguish it must be of great value.

There had been several previous attempts at inventing automatic fire suppression devices, but the first recorded primitive sprinkler system was recorded in 1806 when an English inventor, Mr. John Carey designed a system where water pipes had several valves held shut by counterweights held in place by string. When the fire burnt through the string, the counterweights opened the valves and directed water on to the fire.

In 1864, Major Stewart Harrison of the 1st Engineer (London) Volunteers designed the first crude but recognisable automatic sprinkler head. Unfortunately, although the design was good, the idea was never successfully exploited commercially.

At about the turn of the 19th century, manually operated systems were also invented, but had the unfortunate disadvantage of deluging all the protected property with water, damaging stock in parts of the building unaffected by fire. They quickly went out of fashion.

It was the Americans, Henry Parmelee of Newhaven, Conn. and Frederick Grinnell of Providence, R.I., who continued to improve the design of sprinkler heads and did much to promote the use of sprinklers, educate and develop commercial markets for their products (which included repeated demonstrations of full scale test fires to show the effectiveness of sprinklers).
One of the first commercially successful sprinkler heads was the Parmalee, which incorporated a brass cap held in place by solder which melted and allowed the cap to fall off at about 155 degrees.

The Grinnell No 1 Head was a significant improvement and also used the solder principle.

It was not until 1921 that the first quartz glass bulb sprinkler heads were invented (Grinnell).

In the early years, the fledgling sprinkler industry has had to work hard to educate people as to the advantages of sprinklers. To this day, there are still many misunderstandings amongst some members of the public as to how sprinklers operate, and their effectiveness.
**Sprinklers Today**

Sprinklers are primarily designed to suppress and control fire. They may extinguish a fire, but often this task is finally accomplished by professional firefighters.

Statistics* show that 99% of fires within sprinkler protected buildings were successfully suppressed or extinguished by the system. More than 60% of these fires were controlled by the operation of no more than 4 sprinkler heads.

The number of people killed in sprinkler protected buildings worldwide is very low, and some of these incidents involved explosions and particular fires where sprinklers could not be expected to be so effective. In some cases the sprinkler system was out of commission at the time.

The enhanced levels of life safety, property protection and fire mitigation means that the cost of fires in sprinkler protected buildings is approximately 1/10 of that of unprotected buildings.

The reliability of modern systems is now well established. European statistics reveal that accidental discharge of water from all possible causes is in the order of 1:500,000 per year of service. The Loss Prevention Council (LPC) state that accidental discharge of water due to manufacturing defects is as low as 1: 14,000,000 per year of service.

In the insurance, business and commercial world, sprinklers have been widely accepted and used. For many businesses it has become an insurance requirement to have sprinklers, and in others, discounts on insurance premiums are offered as an incentive to fitting sprinklers.

Sprinklers have also been extensively used in buildings of modern and innovative design and to give greater design flexibility as part of an engineered fire safety solution.

Sprinklers may also be fitted within premises where there are significant fire safety risks or problems which conventional fire safety measures may not address adequately. There have been significant advances in the provision of simpler sprinkler systems for domestic and residential use.

**Scottsdale, USA**

An important public experiment that demonstrates the advantages of sprinklers is on-going in Scottsdale, Arizona, USA. In 1985 the city passed an ordinance requiring sprinklers to be fitted to all new residential and commercial properties. By 1996, 35% of single family homes and 49% of multi-family homes were fitted with sprinklers.

Between 1986 and 1995 there were 598 fires in homes. 44 of these fires were within sprinkler protected buildings.

41 of these fires were controlled or extinguished by the activation of one or two sprinkler heads. The remaining fires were multi-seat flammable liquid arson fires (which sprinkler systems are not designed to cope with).
10 people died in 8 fires during this period. No one died within sprinkler protected buildings. On average, fire losses were found to be 95% less than in un-sprinklered buildings.

Over time, sprinkler installation costs dropped by 45% and insurance companies offered 10% discount on premiums.

Despite this wealth of evidence of the reliability and effectiveness of sprinklers, the general public’s perception of them is often more influenced by what they see in cinemas, television and advertising. Too often, sprinkler operation is misrepresented for comic or dramatic effect, where the hero or villain gets every sprinkler head to operate simultaneously, drenching everything and everyone. This does not happen in reality.
**Sprinkler Design**

Put simply, a sprinkler system is based on plumbing pipes around the risk to be protected. These pipes will have sprinkler heads attached in the risk areas. Water supplies to it will be secure and the whole system will be carefully designed for hydraulic efficiency, reliability and performance in fire. No water will flow within the system unless a sprinkler head operates, or the system is tested by engineers, or a pipe or head is damaged (a rare event).

The following diagram illustrates the main features that will be typically found on a commercial system.
The current design standard for sprinklers is BS EN 12845 - Fixed firefighting systems — Automatic sprinkler systems. Design, Installation and Maintenance.

Design engineers may also use the Loss Prevention Council’s (LPC) Rules for Automatic Sprinkler Installations which now incorporates BSEN 12845.

Crucial to the whole system is a secure and adequate supply of water to be discharged through the sprinkler heads. The most hydraulically remote group of sprinklers must be capable of a prescribed minimum water density discharge.

Whilst soldered heads may still be used, the overwhelming majority of heads now use a quartz glass, liquid filled bulb to hold a sealing plug in place, thereby stopping water flow.
The glass bulb will contain a small bubble of gas. When subjected to heat the gas bubble will expand causing the glass bulb to shatter, the sealing plug to fall away, and water to flow.

Sprinkler heads can be designed for different environments, applications, reaction times, flow rates and heat sensitivities.

The temperature of operation of the head is usually signified by the colour of the bulb. For example, the nominal release temperature of an orange bulb is 57°C, a red bulb is 68°C and a black bulb is 204°C +.

Other temperature bulbs are available.
System types include:

**Wet systems** – where the pipework is permanently charged with water.

**Alternate systems** – where the pipework is charged with water in the warmer summer months, but charged with air when there is a risk of freezing in the winter months. The sprinkler heads operate in the same manner, but a small quantity of air will be discharged first as water makes its way to the activated heads.

**Dry systems** – where the pipework is charged with air. These systems are used in unheated buildings and risks where there is a possibility of freezing.

**Pre-Action system** – these are used to protect high value and/or business critical risks where accidental discharge must be avoided. The advantage of this type of system is that it will provide prior warning of operation and it will not discharge water if a sprinkler head or pipework is accidentally damaged.

The system is linked to heat and smoke detectors within the protected areas. The system is kept dry by means of a deluge valve and air filled diaphragm chamber. Accidental damage will not release the valve but will trigger an alarm. In the event of a fire, the smoke detection will operate raising the alarm and release the deluge valve, charging the system with water ready for operation.

**Recycling systems** – These systems are linked to automatic heat detection and are designed to minimise water use and damage. In the event of fire, both the heat detector and sprinkler head will be operated. As the fire is suppressed or extinguished, the temperature will drop. The heat detector will sense this drop and activate a solenoid controlled valve which will shut off the water supply to the operating heads.
If the fire is not extinguished, the temperature will rise and the heat detector will open the valve again to allow water to be discharged. The system will then re-cycle in this manner until the fire is extinguished or Firefighters have intervened.

**Water mist systems** – whilst similar in concept to and often associated with conventional sprinklers, these are not strictly classified as sprinkler systems and are not covered by the same design standards.

These systems operate at either low pressure (5-12 bar), medium (12 – 34 bar), or high pressure (>35 bar). The discharge heads provide a finely divided water mist (sometimes described as a fog).

In high pressure systems the droplet size can be as small as 70 -100 microns, with a reactive surface area of between 2000m² and 6000m² per litre of water compared to a typical 2m² per litre for conventional sprinklers.

Water mist systems can be very effective in knocking down a fire and the high velocity mist has “searching” properties which allow it to get in and around fixtures, fittings and the burning fuel.

Fires are often extinguished with minimal water use. Water supplies can be from fixed pressurised tanks of limited supply, or may be from a pumped supply giving extended duration of discharge.
Compromised Sprinklers

Situations which could render a system less effective include:

- Type of fire outside design specification, i.e. multiple seats of fire (arson), explosion, etc.;
- Changes to the premises structure, occupancy or use for which the original system was not designed for;
- Failure of the water supply;
- Overdrawing of the water supply (i.e. by Fire Service pumping appliances);
- Sprinkler heads obstructed, i.e. storage of stock too close;
- Shutting down of the system without taking other precautions, i.e. maintenance;
- Premature shutting down of an operating system which is controlling, but has not extinguished a fire.

A sprinkler water supply pipe badly blocked by debris & sludge. Impossible to spot during a fire safety check, effective flow testing and maintenance should identify and eliminate such problems.

Poor management and housekeeping allowing sprinkler heads to be obstructed.
Extensive firefighting operations may result in water mains being over-drawn, having a detrimental impact on fire-fighting jets and the effectiveness of fire sprinklers. Seeking alternative and independent water supplies, or getting the water main pressure and flow boosted, can become a top priority in large incidents.

Photo: The Royal Clarence Hotel Fire, Exeter, 2016. To meet the water supply demands of this incident, pumps were set in to open water from the river Exe, to supplement the supply taken from the water mains.
CHAPTER 12

Introduction to Fire Engineering
What is Fire Engineering?

Fire engineering is the practical application of scientific knowledge and engineering principles within structures and buildings, to provide means to control or contain fire and the products of combustion, so that life is not endangered and property can be protected. This rather long description is not definitive, but does encompass the salient points.

Our scientific knowledge of combustion and its related products, the fire performance of materials and structures and the mechanisms of how fires and smoke develop and spread, has expanded greatly in the last few decades. Research, practical experimentation, post fire analysis and now computer modelling, have all contributed to the development of fire engineering.

These known scientific principles and collected data can now be used to calculate likely fire outcomes for a variety of anticipated fires within different designed buildings, so that structural and engineering systems can be put in place to ensure that an acceptable escape and firefighting environment is maintained.
Fire Engineering in Practice

Fire engineering is a term that is often legitimately used to describe many aspects of fire safety. In the context of this handbook the term is used to describe the approach adopted where traditional and conventional fire safety design features are not appropriate or desirable.

Fire engineered buildings are increasingly commonplace and fire engineering solutions are often encountered with typical examples being; hospitals, large buildings, tall buildings, shopping malls, storage and distribution depots, etc.

Sometimes a fire engineered approach is adopted because there are compelling practical reasons to do, or because the developer and architect want a desirable building of innovative design. Such buildings can be more attractive to prospective occupiers and hence more financially rewarding to its owners.

A feature of such a modern building design is increased reliance on active fire precautions. For example, a sophisticated fire alarm and detection system may be integrated with the buildings other fire defences, so that all, or selected systems are automatically initiated in a fire (or other) emergency.

In some cases the building effectively monitors its own condition and reacts to emergencies itself, often with computer assistance (although override control is always vested with humans!).

In such buildings it is accepted that a fire might occur, but the engineer ensures that it will be contained and controlled to a particular size by providing compartmentation and a comprehensive sprinkler system.
The smoke from this controlled fire will then be “managed” by careful design of smoke channelling, ventilation outlets, and fresh air inlets.

The height of smoke levels and the temperature of the smoke can all be calculated and designed to be within certain parameters so that persons can safely make their escape under it, and Firefighters can make their way in.

A feature of fire engineered buildings is that the active systems are usually integrated, requiring several systems to work together in a co-ordinated way to manage and control the fire.

No two buildings will be exactly the same, so it is impossible to produce a definitive sequence of events for them all. The following example is just one suggestion for a likely sequence of events when a fire occurs.

- The fire alarm operates (manual or detection);
- If fitted, smoke curtains may drop down, or fixed smoke channelling screens will channel smoke into reservoirs;

![Automatic descent smoke channelling curtains dropped down around head of escalator.](image-url)
• High level smoke outlets open (natural ventilation) and if fitted, fans suck out air/smoke from reservoirs (mechanical ventilation);

Automatic smoke vents on roof (natural ventilation).

Four, run to destruction electric smoke extraction fans (forced ventilation).

Seven plenum stacks which can be programmed to extract products of combustion, and in some cases, blow replacement fresh air into the building.
- Low level air inlets open to provide through flow of air;

A large square black panel held in place by electromagnets. When the smoke ventilation system is activated this panel falls outwards to create an inlet for fresh air. The fence surrounding it is to prevent passers-by being hurt when it falls.

- If fitted, activated sprinkler heads control fire size so that it should not exceed its designed parameters (often between 3 and 5 Megawatt output).

All of these features and systems can be supervised and controlled from a dedicated control point or panel. Working together, all these fire engineering installations should maintain the fire conditions at a steady state so that the fire does not grow, smoke is successfully vented, and means of escape is maintained.
Engineers can design systems so that specific parameters can be achieved. For example, the smoke layer should not be less than 3m clear above the heads of people, and the temperature of the smoke above should not exceed 200°C. The steady state should be maintained until such time as professional Firefighters intervene, or the fire burns out.

Fire fighters must familiarise themselves with these buildings, as uninformed interference with these carefully designed systems can make the escape and fire-fighting environment drastically and dramatically worse. Conversely, breakdown or failure of one or more of these engineering systems in normal day to day operation, can leave a building in a potentially very dangerous condition should a fire occur. It may even be necessary to prohibit the use of all or parts of the building!

Fire engineering is a rapidly evolving discipline (especially computer simulation). It must be noted that this chapter provides a very generalised description so that basic principles can be understood. Fire engineering is much more complex, and a detailed study of the subject will reveal many omissions and over-simplifications in this Handbook’s account.
CHAPTE R 13

Fire Risk Assessment
Why Study Fire Risk Assessment?

Operational personnel sometimes ask why they should study fire risk assessment because they are prevented from looking at them during fire safety checks in premises.

Fire risk assessment is an important and fundamental aspect of fire safety. A Responsible Person (RP) with no previous fire background is expected to acquire the knowledge and skills to do them, or understand enough to buy-in such expertise. As professionals we should have the same baseline knowledge as we expect of the people we are checking.

During a fire safety check personnel may be asked questions about fire risk assessment (FRA). It would be very unprofessional of an officer to just shrug his/her shoulders and say “Don't know, never done one. I don’t know anything about it”.

If we (as an organization) are encouraging RPs to download the guidance and comply, shouldn’t we “take a spoonful of our own medicine” and open the same guidance and take a look ourselves?

Whilst operational personnel must not look into, read, or otherwise comment on an RPs fire risk assessment, a walk around the premises to gauge what is happening in practice, will quickly reveal how fire safety is really being managed.

In some cases the risk assessment may appear to be highly satisfactory and complete (if you were to look), yet in reality the premises may be badly managed and even dangerous. You don’t need to look at words on paper to judge whether a premises is safe or not.

Auditing fire risk assessments properly requires a depth of skills and knowledge which the Protection Foundation course cannot impart.
**What is a Fire Risk Assessment?**

Undertaking a “risk assessment” can be daunting for those persons who are unfamiliar with such tasks. Yet risk assessment itself is a very familiar activity.

Even a child contemplating climbing a tree will unconsciously conduct a risk assessment:

- How tall is the tree?
- How difficult is it to climb?
- Is the bark slippery?
- How high should I climb?
- If I were to fall, how hard is the ground?
- Can anyone help me if I get stuck or fall?

Admittedly, children often get themselves into trouble in such matters, but the answers to such questions can sometimes deter a child from climbing. In effect they have risk assessed the situation.

Another familiar risk assessment process is trying to decide whether to cross a busy road or not. With experience we tackle this high hazard activity almost intuitively, yet a similar set of questions to those above could be created, relevant to the specific hazards and risks.

Assessing risk is part of our normal everyday activity.
Whatever risk assessment example you choose, common themes emerge:

- Being observant and gathering relevant information;
- Identifying hazards from that information;
- Evaluating what risks these hazards actually present;
- Avoiding those risks which you believe will cause harm;
- Trying to find no risk or low risk alternatives.

Fire risk assessment, in the context of the Regulatory Reform (Fire Safety) Order 2005, is little different from these basic risk assessment processes, as the description below illustrates:

"A fire risk assessment is an organised and methodical look at your premises, the activities carried on there and the likelihood that a fire could start and cause harm to those in and around the premises."

*Fire Safety Risk Assessment Guide, May 2006*

*Department for Communities & Local Government*

A suitable and sufficient assessment of fire risk?
**Separation of Fire and Health and Safety Hazards & Risks.**

In the Regulatory Reform (Fire Safety) Order 2005 (FSO), “risk” is interpreted as the risk to the safety of persons from fire. When reading the FSO and its supporting guidance it is important to remember the restrictions imposed by this interpretation.

There is a clear statutory separation between the provisions of the FSO and those relating to the Health and Safety at Work Act 1974 (HASAWA) and its subordinate regulations.

Article 4 specifically excludes the FSO from addressing “special, technical or organisational measures” in connection with the carrying on of any work process involving, or in connection with the use of any plant of machinery, or the use and storage of any dangerous substance.

**In all circumstances it is important to remember that the Fire & Rescue Service does not enforce the FSO in relation to any “special, technical or organisational measures”, or any “work process”. These are strictly the domain of the Health and Safety at Work enforcing authorities.**
ARTICLE 9 RISK ASSESSMENT

REQUIREMENT TO CONDUCT A FIRE RISK ASSESSMENT TO IDENTIFY GENERAL FIRE PRECAUTIONS REQUIRED.

REDUCE THE RISK OF FIRE & FIRE SPREAD

MEANS OF ESCAPE;

SECURING THAT, AT ALL MATERIAL TIMES, THE MEANS OF ESCAPE CAN BE SAFELY USED;

MEANS FOR FIGHTING FIRES;

MEANS FOR DETECTING AND GIVING WARNING OF FIRE;

ARRANGEMENTS FOR ACTION TO BE TAKEN IN THE EVENT OF FIRE ON THE PREMISES;

INSTRUCTION AND TRAINING OF EMPLOYEES;

MITIGATE THE EFFECTS OF THE FIRE.

Article 4 – MEANING OF GENERAL FIRE PRECAUTIONS

4.1 DETAILS WHAT "GENERAL FIRE PRECAUTIONS" ARE.

Article 4.2

EXCLUDES FROM GENERAL FIRE PRECAUTIONS ANY "SPECIAL, TECHNICAL OR ORGANISATIONAL MEASURES" IN CONNECTION WITH ANY WORK PROCESS.

Article 2 - INTERPRETATIONS

DEFINES "SPECIAL, TECHNICAL OR ORGANISATIONAL MEASURES"

TECHNICAL MEANS OF SUPERVISION;
CONNECTING DEVICES;
CONTROL AND PROTECTION SYSTEMS;
ENGINEERING CONTROLS AND SOLUTIONS;
EQUIPMENT;
MATERIALS;
PROTECTIVE SYSTEMS; AND WARNING AND OTHER COMMUNICATION SYSTEMS;

Article 4.3

DEFINES "WORK PROCESS" AS INVOLVING OR IN CONNECTION WITH THE USE OF PLANT OR MACHINERY OR THE USE/STORAGE OF DANGEROUS SUBSTANCES.

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The Legal Requirement to Fire Risk Assess

FSO Article 9:

The Responsible Person must make a suitable and sufficient fire risk assessment to identify the general fire precautions he needs to take. The assessment must be reviewed to keep it up to date.

To find out what “general fire precautions” are, you must turn to Article 4 which describes them as measures:

- to reduce the risk of fire and fire spread on the premises;
- in relation to the means of escape from the premises;
- for securing that, at all material times, the means of escape can be safely and effectively used;
- in relation to the means for fighting fires on the premises;
- in relation to the means for detecting and giving warning of fire on the premises;
- in relation to the arrangements for action to be taken in the event of fire on the premises, including:
  - measures relating to the instruction and training of employees; and
  - measures to mitigate the effects of the fire.
The Principles of Prevention

Article 10 of the FSO directs the Responsible Person to Schedule One, Part Three, where the Principles of Prevention are set out. Any preventive and protective measures must be based on this hierarchy of principles. The principles will be referred to by the Courts and used as a benchmark where the suitability and sufficiency of a fire risk assessment, and the actions taken are in question.
Recording the Fire Risk Assessment

The significant findings of the assessment and persons identified as being especially at risk must be recorded if:

- He employs five or more employees;
- A license* under an enactment is in force in relation to the premises;
- An Alterations Notice requiring this is in force in relation to the premises.

The information to be recorded must include:

(a) the significant findings of the assessment, including what measures are being taken, and;

(b) any group of persons identified by the assessment as being especially at risk (e.g. lone workers, people with disabilities, expectant mothers, children, etc.).

The fire risk assessment must be reviewed regularly so as to keep it up to date, especially if there is reason to suspect it may no longer be valid or there have been significant changes to the matters to which it relates.

*License – examples include registered Houses in Multiple Occupation (HMOs), care homes, theatres, cinemas, premises selling alcohol, e.g. hotels, restaurants, cafés, pubs, nightclubs, music venues, etc.
**Informing Employees**

Article 19 requires the Responsible Person to provide his employees with comprehensible and relevant information on:

(a) the risks to them identified by the risk assessment;

(b) the preventive and protective measures;

(c) emergency procedures and drills in the event of serious or imminent danger;

(d) the identities of those persons nominated as first-aid firefighters or who will be responsible for assisting with emergency procedures and drills;

(e) the relevant risks in another premises/occupiers fire risk assessment which have been relayed to him.

The information may need to be supplied in other languages or formats if it can be anticipated that staff may experience difficulty understanding the information.
Dangerous Substances

Dangerous substances must be taken into account if they are present within the premises undergoing fire risk assessment.

A dangerous substance is:

- any substance or preparation which is explosive, oxidising, extremely flammable, highly flammable or flammable;

- a substance which because of its physico-chemical or chemical properties and the way it is used or is present in or on premises creates a risk; and

- any dust (solid particles or fibrous materials or otherwise) which can form an explosive mixture with air, or an explosive atmosphere.

Schedule One, Part One of the FSO gives a list of matters to be considered when assessing the risks from dangerous substances.

In Article 12, the Responsible Person is required to eliminate or reduce the risk as far as is reasonably practicable. Measures to achieve this could include, replacement with a non-dangerous substance, taking measures to control the risk and mitigate the detrimental effects of any fire. The Article refers to Part 4 of Schedule One of the FSO for further details on control measures.
Where a dangerous substance is present in or on the premises, the Responsible Person must inform his employees of:

- the details of any such substance including –
  - the name of the substance and the risk which it presents;
  - access to any relevant safety data sheet; and
  - legislative provisions (concerning the hazardous properties of any such substance) which apply to the substance; and
- the significant findings of the risk assessment.
**Young Persons**

The FSO recognizes the inexperience, lack of awareness of risks and immaturity of young persons (under 18). In relation to young persons, Schedule 2, Part 1, of the FSO sets out a range of matters which must be taken into account in the fire risk assessment.

- the fitting-out and layout of the premises;
- the nature, degree and duration of exposure to physical and chemical agents;
- the form, range, and use of work equipment and the way in which it is handled;
- the organisation of processes and activities;
- the extent of the safety training provided or to be provided to young person’s, and;
- risks from agents, processes and work listed in the Annex to Council Directive 94/33/EC (a) on the protection of young people at work.

If a child or young person is employed, the parent of the child must be provided with comprehensible and relevant information on the risks to that child identified by the fire risk assessment.
Fire Risk Assessment in Practice

It cannot be over-emphasised that the burden for conducting a fire risk assessment rests with the Responsible Person.

Fire risk assessment is not simply a bureaucratic chore to keep the fire authorities happy. Fire risk assessment is a valuable tool to help manage risk. The findings of this assessment should provide the basis and direction for everything that needs to be done to keep people safe from fire.

A fire risk assessment may even identify other ways and means of keeping relevant people safe which are more practicable or cost efficient and which enable a departure from the conventional recommendations and guidance offered in codes of practice. In these situation, the competence of the assessor, and the “suitability and sufficiency” of his/her assessment will be under close scrutiny to ensure that acceptable standards of safety are actually being maintained.

Many Responsible Persons do not have underpinning knowledge and experience of fire related matters, and some are unfamiliar with the concept and practices of risk assessment generally.

Even if asked to help, FRA personnel must not be tempted to get involved in the risk assessment process. Instead, Officers should inform the person:

- How they can access official sources of guidance and advice so that they can undertake the task themselves, or;

- If this is not desirable, that private consultants or specialist firms can offer a commercial alternative;
That the FRS role is to audit others fire risk assessments and take enforcement action as appropriate. Any advice offered is on a goodwill basis and will be restricted to general guidance only.

During a Fire Safety Check, operational personnel are restricted to asking whether a fire risk assessment exists and whether it is current. Personnel are not tasked with looking at the detail of any assessment, or expressing an opinion as to its suitability and sufficiency.

Do not attempt to read a fire risk assessment, even if invited to do so. If you do take a cursory look, the person handing it to you might assume, or subsequently argue that your failure to comment was a sign that all was well and the risk assessment must have been deemed to be suitable and sufficient.

A simple appraisal of how the premises fire safety arrangements appears to be managed in reality is far more revealing.
Fire Risk Assessment Principles

To undertake a fire risk assessment some simple terms have to be understood first.

Hazard = anything that has the potential to cause harm.

Risk = the chance of that harm occurring.

People often confuse these two terms and assume they mean the same thing. They do not.

For example, in the illustration below the sticks of dynamite are a hazard because they are explosive.

Yet dynamite is safely manufactured, stored, transported and used. The fact that this occurs does not mean that they are no longer explosive. The hazard remains constant.

Hazard = Explosives

The risk they present is that they could be accidentally and unintentionally detonated. Such an event could cause death injury and widespread destruction.

Risk = Likelihood of uncontrolled explosion
Whether such an explosion will occur depends on many factors such as method of manufacture, conditions of storage and transport, competence of handlers and users, etc. The risk is variable.

The objective of risk assessment is to identify the hazard, evaluate and quantify the risks, and then take steps to remove, avoid or control the risks.

Risk Assessment
- Identify
- Remove
- Control/Manage

When conducting a fire risk assessment the Tetrahedron of Fire should always be borne in mind. Extinguishing or preventing fire is as simple as removing one element of the tetrahedron.

For example, if a factory has to undertake hot work processes it will be important to ensure that the hot work cannot set fire to any fuel and allow fire to spread.
If a warehouse stores large quantities of combustible materials then it is important to remove or control any potential ignition sources.

On rare occasions it may be genuinely impractical or impossible to remove or avoid the potential for either ignition sources, or fuel sources to be present. If a factory with a high through-put of manufactured goods has a process where ignition and fuel sources are unavoidable (e.g. the spraying of flammable paints) then it may be possible to create a fully automated production line thereby removing the threat to life. The hazard of fire can then be minimised by adopting sophisticated rapid response automatic fire detection and suppression systems.

**ALARP**

For any hazard or risk that cannot be removed or avoided, or where a residual risk remains, the concept of trying to reduce risk to As Low As Reasonably Practicable (ALARP) should be adopted. This means that you have to take action to control the risks in your workplace except where the cost (in terms of time and effort as well as money) of doing so is 'grossly disproportionate' to the reduction in the risk.
Fire Risk Assessment Methods

There are numerous different risk assessment methods that could be adopted by a Responsible Person and many fire & rescue services offer free and simple risk assessment tools on their websites.

It is not practical to attempt to give any specific detailed information about any one system or method. Therefore this handbook focuses on generic principles, common methodologies and the official guidance given in Government publications. An understanding of these generic principles will be key to conducting a fire risk assessment and, should the need arise, auditing an assessment.

Methods can vary from the relatively simple and subjective, through to more complex quantitative scoring systems. Many methods are common or similar to those used in health and safety or engineering. In all cases, the fire risk assessor must possess a sound working knowledge of fire safety. Subjectivity and opinion can never be eliminated.

Methodologies that could be encountered include:

Subjective

This approach is based upon the risk assessor’s opinion about the hazards and risks they have identified and their judgement as to their seriousness and priority. Such assessments often consist of written descriptions and explanations about what has been seen and done.
Risk Value Matrix

This approach allows the risk assessor to assign a numerical value to identified hazards and their associated risks. Matrices come in different sizes (3 x 3, 4 x 4, etc.). Typically, scoring is kept simple and each score has a descriptor. By multiplying together the assigned values for hazard severity and risk likelihood, an overall numerical risk value can be calculated which can be used to determine priorities. It must be noted that judgement and subjectivity is still required and whilst it may appear to be a quantitative system, the numerical value derived are relative and have no significance other than to guide decision making.

Example of a 5 x 5 risk value matrix

<table>
<thead>
<tr>
<th>LIKELIHOOD</th>
<th>FIRE SEVERITY &amp; CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>ALMOST CERTAIN</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>VERY PROBABLE</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>POSSIBLE</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>REMOTE POSSIBILITY</td>
<td>2</td>
</tr>
<tr>
<td>EXTREMELY UNLIKELY</td>
<td>1</td>
</tr>
</tbody>
</table>
Publically Available Specification (PAS) No. 79

PAS 79 is a very commonly used guidance document, published by the British Standards Institute (BSI), which sets out a process for carrying out a fire risk assessment.

The process requires that the fire risk assessor properly consider a comprehensive range of topics, including: general premises information, fire hazards and their elimination and control, means of escape, fire warning, firefighting equipment, management, testing, maintenance and much more.

The PAS 79 publication contains a very useful template that provides a means of documenting the findings of a fire risk assessment and includes a risk estimator tool and associated guidance (though other styles of documentation could also be acceptable).

<table>
<thead>
<tr>
<th>LIKELIHOOD OF FIRE</th>
<th>SLIGHT HARM</th>
<th>MODERATE HARM</th>
<th>EXTREME HARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>TRIVIAL RISK</td>
<td>TOLERABLE RISK</td>
<td>MODERATE RISK</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>TOLERABLE RISK</td>
<td>MODERATE RISK</td>
<td>SUBSTANTIAL RISK</td>
</tr>
<tr>
<td>HIGH</td>
<td>MODERATE RISK</td>
<td>SUBSTANTIAL RISK</td>
<td>INTOLERABLE RISK</td>
</tr>
</tbody>
</table>

Table 1. Risk level estimator tool similar to that provided in PAS 79

(© & courtesy of C. S. Todd & Associates - http://www.cstodd.co.uk )
The assessor has to possess a sound working knowledge of fire safety and whilst there is still a substantial element of subjective assessment, the specification does provide a reliable and consistent framework and method which is widely accepted and popular.

**Algorithm**

An algorithm is simply a set of pre-determined rules or steps that can be followed to arrive at a resolution or solution. These fire risk assessments are often set out in the form of a flowchart. Progress is made through the algorithm by answering yes/no questions which direct the assessor to determine risk and priorities.

The creation of a flow-chart to take into account all relevant and potentially significant circumstance usually requires some information gathering, qualitative and quantitative analysis and effort. It is very likely that a generic flow chart will be unsuitable for many premises, so such methods tend to be bespoke and reserved for premises with more complex hazards and risks.
An example of a simplified algorithm risk assessment flow chart
Probabilistic Risk Assessment and Logic Trees

These types of methods have their roots in health and safety, and in particular, industrial process and engineering applications. They are best adopted by advanced practitioners trained and experienced in their use. This handbook cannot provide the detail and information required to fully understand such methods, so the following descriptions are intended to provide a general awareness only and are not intended to be studied in depth.

In essence, probabilistic risk assessment uses mathematical techniques in conjunction with data and statistics to calculate the likelihood of different events occurring and assign a numerical value to represent the level of hazard presented to people or property.

These methods are most commonly used with logic trees which are relatively simple graphics used to map-out a series of linked events which could result in a particular outcome (e.g. a fire or its consequences) and assign a probability value to each stage. There are two type of logic trees; event and fault trees.

Event Trees

Event trees are often used when there is little reliable data concerning infrequent outcomes (e.g. large multiple death fires). These work forward from an initiating event such as ignition, and generate branches which set-out possible paths to different outcomes via yes/no gates. By assigning probabilities to each branch of the tree it should be possible to arrive at a numerical value expressing the probability of different outcomes.

Event trees can be quite extended, but the following explanation and example (based upon figure 6 given in PD 7974-7:2003) provides a shortened and simplified tree to illustrate the principle.
Historical statistical data has been obtained which indicates that a fire is likely to occur within the property type, approximately once every four years (0.24 probability).

The first logic yes/no gate is posed by the question “is the fire restricted to the first item ignited?” Statistical data indicates that there is a 60% or 0.6 probability chance that it will, and a 40% or 0.4 chance that it will spread to other items.

Assuming that the fire is spreading, the next yes/no gate poses the question “Is the fire detected less than five minutes from ignition?” Again, past data indicates that there is a 50/50 chance that it will.

**Simplified example of an event tree** *(based upon PD 7974-7:2003, figure 6, page 20)*

```
  IGNITION  
    ↓     
  0.24 FIRES PER YEAR  
    ↓  
  (approximately once in every four years)  
    ↓  
  FIRE RESTRICTED TO FIRST ITEM IGNITED?  
    ↓  
  YES  
    ↓  
  0.6  
    ↓  
  NO  
    ↓  
  0.4  
    ↓  
  IS FIRE DETECTED IN < 5 MINUTES FROM IGNITION?  
    ↓  
  YES  
    ↓  
  0.14  
    ↓  
  NO  
    ↓  
  0.5  
    ↓  
  0.05  
    ↓  
  (approximately once in every 20 years)  
    ↓  
  0.5  
    ↓  
  0.05  
    ↓  
  (approximately once in every 20 years)  
```
By simply following each branch and multiplying the probabilities, you can arrive at a probability frequency value.

- Fire igniting and restricted to item
  
  \[ 0.24 \times 0.6 = 0.14 \] or once in every seven years

- Fire igniting, spreading to other items and being detected in <5 minutes
  
  \[ 0.24 \times 0.4 \times 0.5 = 0.05 \] (rounded) or once every 20 years

- Fire igniting, spreading to other items and being detected in >5 minutes
  
  \[ 0.24 \times 0.4 \times 0.5 = 0.05 \] (rounded) or once every 20 years

As is always the case, great caution has to be exercised when using statistics and data to ensure its currency and relevance to the problem in hand. A degree of pragmatism has to be factored in. Just because an event will probably only occur once in every 20 years, it gives no indication when that event will occur. What this actually means is that every year there is a 1 in 20 chance of that event occurring. This technique is probably best used to assist cost/benefit analysis or effectiveness comparison of fire precautions that could be adopted.

**Fault Trees**

Fault trees start from the anticipated end result by working backwards logically through the contributory factors. Pathways are usually followed via and/or gates which guide the user back to root events.
In the simple and condensed example below it is anticipated that a computer could catch fire. For this to happen the computer would have to overheat and its electrical circuit protection would have to fail. For the overheat to happen either a power surge would have to occur, or the user could accidentally spill their coffee onto their computer.

Simplified example of a fault tree

If data is known about the individual component parts or steps in the tree, it is possible to assign probabilities to each component or step and using a different mathematical technique from that described previously, derive an overall probable outcome for the end result.

In summary, all these probabilistic methods use either current or historical information or data to predict future performance. The engineering and process sectors often have accurate data about the
reliability of systems and components (often from manufacturers who have tested their products, sometimes to destruction) and are therefore able to make reasonably accurate probability calculations.

For example, an engineer may be working on the design of an industrial chemical process which has the potential to cause a fire or explosion. Using such methods might reveal that it is safer and more cost efficient to upgrade the specification of a particular component, or to highlight that a component will need to be serviced or replaced at specific intervals in order to avoid catastrophic failure.

Similar data for general fire risk assessment is sparse and not always current, so probabilities are less accurate and outcomes less certain. A sensitivity analysis will have to be conducted to encompass varied probabilities and test the robustness of any decisions based upon the method. It follows that such methods are often reserved for more complex premises or for defined systems and processes where reliable data is available.
Choosing a Method

It is up to the Responsible Person to decide what risk assessment method and process to adopt. The emphasis should be on achieving successful and practical outcomes rather than getting bogged-down or entangled in overly complicated methodologies. As a general “rule of thumb” it is nearly always best to choose a relativity simple and user friendly (to the assessor and end users) process and recording method.

The law does not prescribe every detail of what a fire risk assessment should contain. Remember, producing a written record of the fire risk assessment is not the sole focus. The assessment is a useful tool for reducing and managing risk and the record made has a supplementary function of providing hard evidence that the Responsible Person can use to demonstrate that they have managed their hazards and risks in an appropriate way.

DCLG guidance suggests the aims of the fire risk assessment are:

- To identify the fire hazards.

- To reduce the risk of those hazards causing harm to as low as reasonably practicable.

- To decide what physical fire precautions and management arrangements are necessary to ensure the safety of people in your premises if a fire does start.

The guidance also suggests that the fire risk assessment should:

- Be conducted in a practical and systematic way

- Have enough time allocated to do the job properly
Protection Handbook

- Include the whole of your premises, including outdoor locations and any room and areas that are rarely used

- In small premises it may be possible to assess them as a whole. In larger premises divide them into rooms/assessment areas using natural boundaries.

Ideally a competent person should conduct the fire risk assessment as this is most likely to aid the production of a document which is suitable and sufficient. A competent person is usually defined as someone who has sufficient training and experience or knowledge and other qualities to conduct the task required. In any dispute over competence, or the suitability and sufficiency of an assessment, it will be for the Courts to decide.

The guidance recommends adopting a five stage approach. This brings fire risk assessment into line with existing health and safety risk assessment recommendations.
FIRE SAFETY RISK ASSESSMENT

1 Identify fire hazards
   Identify:
   Sources of ignition
   Sources of fuel
   Sources of oxygen

2 Identify people at risk
   Identify:
   People in and around the premises
   People especially at risk

3 Evaluate, remove, reduce and protect from risk
   Evaluate the risk of a fire occurring
   Evaluate the risk to people from fire
   Remove or reduce fire hazards
   Remove or reduce the risks to people
   • Detection and warning
   • Fire-fighting
   • Escape routes
   • Lighting
   • Signs and notices
   • Maintenance

4 Record, plan, inform, instruct and train
   Record significant findings and action taken
   Prepare an emergency plan
   Inform and instruct relevant people
   co-operate and co-ordinate with others
   Provide training

5 Review
   Keep assessment under review
   Revise where necessary
The following fire risk assessment form can be found in the HM Government Fire Risk Assessment Guides.

<table>
<thead>
<tr>
<th>Risk Assessment – Record of significant findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk assessment for</strong></td>
</tr>
<tr>
<td>Company:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sheet number</th>
<th>Floor/area</th>
<th>Use</th>
</tr>
</thead>
</table>

**Step 1 – Identify fire hazards**

<table>
<thead>
<tr>
<th>Sources of ignition</th>
<th>Sources of fuel</th>
<th>Sources of oxygen</th>
</tr>
</thead>
</table>

**Step 2 – People at risk**

**Step 3 – Evaluate, remove, reduce and protect from risk**

(3.1) Evaluate the risk of the fire occurring

(3.2) Evaluate the risk to people from a fire starting in the premises

(3.3) Remove and reduce the hazards that may cause a fire

(3.4) Remove and reduce the risks to people from a fire

**Assessment review**

<table>
<thead>
<tr>
<th>Assessment/review date</th>
<th>Completed by</th>
<th>Signature</th>
</tr>
</thead>
</table>

**Review outcome** (where substantial changes have occurred a new record sheet should be used)

[http://www.gov.uk Fire Safety in the Workplace]
The Study Book for the NEBOSH Certificate in Fire Safety and Risk Management states that for a fire risk assessment to be deemed suitable and sufficient it must:

1) Identify all the hazards and evaluate the risks from those hazards, taking into account legal requirements;

2) Record the significant findings;

3) Identify any group of employees or single employees who are especially at risk (e.g. lone workers, people with disabilities, etc.);

4) Identify others who may be especially at risk (e.g. members of the public, visitors, contractors, children, expectant mothers, etc.);

5) Evaluate existing controls, stating whether they are satisfactory, and if not, the action necessary;

6) Evaluate the need for further controls including information, instruction and training;

7) Be carried out by a competent person (s) who have the necessary experience or training in hazard identification and carrying out risk assessments, knowledge of the process or activity, and good communication and reporting skills. The individual(s) should have the right attitude to carry out the task, the ability to interpret legislation and guidance, and technical knowledge of the plant or equipment involved.

Whilst this is an authoritative source for guidance, it is not law.
Another way of deciding whether a fire risk assessment is suitable and sufficient is to look at the end result. If the assessment is part of the process of managing fire risks so that no relevant person is put at risk of death or injury from fire, then it is likely to be suitable and sufficient.

Conversely, if relevant persons are put at avoidable risk of death or injury from fire, then it is likely that the fire risk assessment will not be suitable and sufficient. The assessment itself and its associated fire risk management could be flawed in several respects.
How Much Needs to be Recorded?

In trying to determine what should be recorded, several factors have to be taken into account:

The size and complexity of the premises being assessed.

Larger premises with complex and varied risks, where large numbers of people could be affected by any fire, will benefit from having a more detailed approach taken. Conversely, simple premises of low or normal risk are not likely to need so many details recorded.

Deciding what is significant

The term “significant findings” is open to some interpretation. To some assessors this means you only have to record the most blatantly obvious hazards and risks. To others, a more comprehensive approach is taken and every single aspect of the assessment is meticulously recorded.

Not too many years ago, many people would have been familiar with lighting fires, probably within a domestic fire grate, or perhaps lighting a garden bonfire. With the decline of such activities many people do not possess a basic understanding of what it takes to get a fuel to burn.

When conducting a fire risk assessment, the ability to identify ignition sources, fuel sources and potential mechanisms for fire spread, is essential. With our collective background knowledge of combustion eroded, how will a fire risk assessor identify significant ignition and fuel sources?
This question becomes even more difficult when one considers the ignition and fuel sources that are likely to be encountered within many premises.

Will the average shop keeper understand that a display of potato crisps is readily ignitable and burns vigorously? Will the owner of a highly mechanised wood machining and processing factory be aware of the problems of static electricity, spontaneous ignition of waste materials and the potential for dust explosions?

Where a Responsible Person recognises that a knowledge gap may exist and either acquires, or buys in the necessary knowledge and skills, there should not be too many problems in deciding what is significant. Where the knowledge gap has not been recognised, the potential for significant hazards and risks to be overlooked is quite high.

Firefighters are highly trained and experienced in many aspects of combustion and fire dynamics. It is likely that from time to time personnel will encounter a set of circumstances which lead them to doubt whether all ignition and fuel sources have been identified within a premises.

Proving that all hazards and risks have been identified and evaluated.

In any assessment it is likely that some hazards and risks will have been identified, evaluated and discounted as not being “significant” and therefore not recorded.

What if significant hazards and risks have been accidentally overlooked? As with any human activity, the chance of mistakes being
made will be ever present. A fire risk assessment which has sufficient
detail can demonstrate that the assessment has been thorough.

Audit and Legal Protection

A fire risk assessment may be inspected by an enforcing authority, and
it may even appear as evidence in a Court case. If too little detail is
recorded and the omissions reveal that relevant persons have/are being
put at risk, then the assessment may be deemed not to be “suitable
and sufficient”.

A similar approach is adopted by the Health and Safety Executive. In
their Management of Health and Safety at Work Regulations 1999,
Approved Code of Practice & Guidance, it stated:

"In many cases, employers (and the self-employed) will also need to
record sufficient detail of the assessment itself, so that they can
demonstrate (e.g. to an inspector or to safety representatives or other
employee representatives) that they have carried out a suitable and
sufficient assessment."

This code of practice has been subsequently withdrawn, but it could be
argued that this statement remains good advice. Ultimately it is for the
fire risk assessor to decide what is to be recorded, but he or she must
always be mindful of the factors listed above when making such
decisions. It would be prudent to include references to those positive
fire safety features and arrangements within a building or premises,
which contribute to any decision to take, or not take any action.
CHAPTER 14

Principles of Good Enforcement
The Principles of Good Enforcement

The Fire and Rescue Service has been given significant statutory duties and powers under the FSO. This brings with it accountability and responsibility to exercise these duties and powers in an appropriate way.

From time to time, individuals, business and commerce have complained about the practices, procedures and attitude of the many organisations and bodies that have an inspection and law enforcement role.

To guide organisations and bodies good practice protocols and statutory codes of practice have been created.

History

The Enforcement Concordat

The Government introduced the voluntary Enforcement Concordat in 1998 in collaboration with business, local and national regulators. The aim was to promote good enforcement that brings benefits to business, enforcers and consumers. The Enforcement Concordat encouraged partnership working between enforcers and businesses, and set out the Principles of Good Enforcement which enforcers should apply in order to achieve higher levels of voluntary compliance. The principles are:

- Standards - setting clear standards;
- Openness - clear and open provision of information;
- Helpfulness - helping business by advising on and assisting with compliance;
- Complaints - having a clear complaints procedure;
Protection Handbook

- Proportionality - ensuring that enforcement action is proportionate to the risks involved;

- Consistency - ensuring consistent enforcement practice.

Over 96% of all central and local government organisations with an enforcement function adopted the Enforcement Concordat although it remains purely voluntary. It is now generally deemed to be withdrawn as it has been over-taken by the introduction of the statutory Regulators Code.

The Hampton Principles

Nearly ten years after the Enforcement Concordat was introduced, the review in 2004 by Sir Philip Hampton (Reducing administrative burdens: effective inspection and enforcement) was influential in promoting new approaches to inspection and enforcement which include:

- Increased use of risk assessment to precede and inform all regulatory enforcement work;

- Increased use of support and advice to help businesses to understand and meet regulatory requirements more easily; and,

- Adopting proportionate, targeted and flexible approaches to applying the law and securing compliance.

The review found that the current regulatory system imposed too many forms, duplicate information requests and multiple inspections on businesses.

In his final report, Hampton proposed:

- reducing inspections where risks are low, but increasing them where necessary;
• making much more use of advice, applying the principle of risk assessment;

• substantially reducing the need for form-filling and other regulatory information requirements;

• applying tougher and more consistent penalties where necessary;

• reducing the number of regulators that businesses deal with from thirty-one to seven;

• entrenching reform by requiring all new policies and regulations to consider enforcement, using existing structures wherever possible;

• creating a business-led body at the centre of government to drive implementation of the recommendations and challenge departments on their regulatory performance.

As a result of this final recommendation, the Government created the Better Regulation Executive (BRE) to oversee the reduction of regulatory burdens on business, and hold government departments and regulators to account.

The Hampton Review set out some key principles that should be consistently applied throughout the regulatory system:

• regulators, and the regulatory system as a whole, should use comprehensive risk assessment to concentrate resources on the areas that need them most;

• regulators should be accountable for the efficiency and effectiveness of their activities, while remaining independent in the decisions they take;

• no inspection should take place without a reason;

• businesses should not have to give unnecessary information, nor give the same piece of information twice;
the few businesses that persistently break regulations should be identified quickly and face proportionate and meaningful sanctions;

regulators should provide authoritative, accessible advice easily and cheaply;

regulators should be of the right size and scope, and no new regulator should be created where an existing one can do the work;

regulators should recognize that a key element of their activity will be to allow, or even encourage, economic progress and only to intervene when there is a clear case for protection.

The Regulators Compliance Code

This was the statutory code of practice that was adopted to incorporate and enshrine the Hampton Principles. Every UK FRS should have drafted and implement its Protection inspection and enforcement policies in compliance with this Code. It has been superseded by the Regulators Code.

Regulators’ Code

The Regulators’ Code is a statutory Code of Practice that replaces the Regulators Compliance Code (RCC). It came into force by Statutory Instrument in April 2014.

The Regulators’ Code introduces clearer requirements for regulators and assist in enabling greater transparency for business, regulation bodies and citizens about the role of the regulators in delivering prosperity and protection.
The Code is underpinned by the principles of good regulation, which provide that regulatory activities should be carried out in a way which is transparent, accountable, proportionate and consistent and should be targeted only at cases in which action is needed.

The Code states that regulators should:

1. Carry out their activities in a way that supports those they regulate to comply and grow;
2. Provide simple and straightforward ways to engage with those they regulate and hear their views;
3. Base their regulatory activities on risk;
4. Share information about compliance and risk;
5. Ensure clear information, guidance and advice is available to help those they regulate meet their responsibilities to comply;
6. Ensure that their approach to their regulatory activities is transparent.

Fire and Rescue Services will need to have regard to the Code when developing standards, policies or procedures that guide their regulatory activities with businesses.

**Powers of Entry – Code of Practice - 2014**

Issued under Section 48 of the Protection of Freedoms Act 2012, this new code of practice relates to powers of entry for non-police agencies and introduces a range of statutory obligations regarding enforcement.

The aim of this code is to:

• Minimise disruption to business;
Protecting greater consistency in the exercise of powers of entry;

- Provide greater clarity for those affected by them;

- Upholding effective enforcement.

As this code primarily impacts on the work of specialist Protection officers, no further explanation will be given in this handbook.

The full code can be read at:

Primary Authority Schemes

Many businesses and organisations trade and operate across the UK and as a result may have to deal with numerous different regulatory authorities. In such circumstances there is the potential for variances in the enforcement approach in different areas and regions which could cause delay, frustration and which will ultimately be bad for business.

In an effort to tackle this problem the Regulatory Enforcement and Sanctions Act of 2008 introduced the Primary Authority Scheme (PAS) applicable to the majority of local authority regulatory services. The concept behind this is to provide reliable and consistent regulatory advice for the business or organisation involved, and a simplified approach to getting things done.

In 2014 the scheme was extended to include regulation under the FSO and it provides a statutory basis for a fire authority to become the single point of contact for fire safety regulation and advice for businesses and organisations operating across more than one local authority enforcement area.
Under the scheme, a business, organisation or group (where coordinated by a third party such as a trade association or franchisor) can select a fire and rescue authority to become its primary authority under a formal PAS partnership agreement.

Services provided by the primary authority (PA) may include:

- Assured advice - acceptable to enforcers nationally
- Inspection Plans – agreed between the regulator, the business and the local fire and rescue service, to coordinate but not direct inspection activity
- Enforcement referral - the ability for the partner regulator to block any proposed enforcement action not consistent with the assured advice it has given to the business, or organisation.

The impact of this scheme on day-today enforcement activity is that before any fire safety check or audit under the FSO is contemplated, the FRA should check whether the target premises or business is covered by a PAS as this will have a significant impact on what the local FRS can and cannot do. However, it should be noted that a PAS does not inhibit a local FRA serving a Prohibition Notice under article 31 of the FSO if it believes it is necessary.

Despite this pre-inspection check it is possible that a premises or business covered by a PAS may slip through-the-net and operational crews may only find out that such a scheme is in operation when they arrive at the premises. In such circumstances the crews ought to withdraw and refer the matter to their specialist Protection department.
CHAPTER 15

Organising a Fire Safety Check
Organisation

Taking into account the dynamic and changing nature of fire station activities and operational demands, it is highly probable that from time to time personnel will encounter problems when trying to organise a fire safety check.

Here are a few simple guidelines which will help to minimise the disruption:

- Premises to be visited are allocated to Stations having been vetted to ensure that no formal fire safety enforcement action is underway. There should normally be no problems with proceeding. However, mistakes can be made. If you have concerns that the premises is not suitable for a simple fire safety check (e.g. too large or complex), or your local intelligence alerts you to the fact that there could be serious problems within the premises, then seek clarification from your Line Manager or Support Officer.

- For simple, small premises, making an appointment to visit may not be necessary but always follow service policy. This is also the case for pre-Christmas inspections and During Performance inspections. However, for medium to larger sized premises, or those where arriving unannounced could cause complications (schools, colleges, banks, secure premises, etc.) it is advisable to try to make an appointment for your visit at a mutually convenient time.

- Contact information may be available from Administration Support, or may be obtained from local sources (local knowledge, Yellow Pages, internet, etc.).

- As far as possible, try to ensure that any appointment is made with the Responsible Person or their authorised representative.
You may need to discuss this with your premises contact to ensure that you deal with the right person during the visit.

- If you suspect that there may be language barriers to communication during the visit, try to persuade the occupier to have someone fluent in both languages present during the visit, so that they can act as an interpreter.

- Ensure that the Responsible Person or their authorised representative is aware of the nature of the visit, its likely duration, and give an outline of what matters will be enquired into.

- When making appointments, explain the nature of the visit and that operational commitments may suddenly arise which could result in you not turning up, not turning up exactly on time, or having to leave early. It may be advisable to suggest an approximate attendance time (i.e. 14:00 to 14:30). Failure to show up without any prior explanation can cause great frustration and disruption to the occupiers, but most people will be satisfied with an explanation.

- Keep an accurate and legible desk diary to record names, addresses, contact details and appointment times. Not only will this help you keep track, but it may also help colleagues who may need to cancel the appointment on your behalf.

- Give yourself plenty of time to get to the appointment and try to be on time. It makes a good first impression and shows efficiency.

- Responsible people will need to know who you are and you must be able to show your written authority. This is most likely to occur in secure premises such as banks, post offices and some Government
buildings. Some Fire Stations have produced generic business cards which may be left to provide contact details.

- Make sure you have all relevant forms and paperwork. Try to anticipate whether any leaflets may be useful to the visit (i.e. arson prevention, etc.).
CHAPTER 16

Interpersonal Skills.
**Introduction**

Fire and Rescue Service personnel regularly and routinely interact with members of the public, especially in their operational role, where their arrival is usually greeted with relief and appreciation.

Conducting a fire safety check in a premises has the potential to initiate formal fire safety enforcement. It is not uncommon for some occupiers and business owners to regard such a visit with suspicion or even anxiety. Concerns that they may get into trouble, or that there may be financial repercussions from the visit may be foremost in their mind, especially if they have been ignoring or neglecting their statutory fire safety responsibilities.

Studying interpersonal skills may seem like an exercise in “egg sucking” as most people believe their own people skills are satisfactory or even good. Yet, who hasn’t at some time received poor service, attitude or indifference when out shopping, dining or making a complaint? Could it be that these very same people who caused you irritation and dismay believe that they too have good interpersonal skills and customer service ethos?

FRS personnel will benefit from being aware of good practice in conducting checks and dealing with individuals so that they can acquire or learn the skills that put people at ease, and if necessary subtly manipulate the situation so that the Responsible Person is happy to comply, and may even see the solution to any problem as his/her own idea.
Attitude

Many if not most Operational personnel have first-hand experience of dealing with death or injury arising from fire incidents, and have seen the damage and destruction that fire can bring. This can sometimes cause personnel to feel highly motivated, if not passionate about trying to prevent fire occurring. This is not a bad thing, but needs to be tempered with common sense, a little pragmatism, and an understanding that fire is not necessarily foremost in the mind of people running businesses.

The following guidelines may be helpful:

- When visiting premises, leave the “macho” image behind. This type of attitude may be interpreted as demonstrating a lack of knowledge, or confidence;

- Be honest with yourself and others, recognising your own limits of competence and authority. Most people will thank you and respect you for it;

- Don’t patronise people, but don’t let people over-awe you either;

- Adopt a polite, friendly but formal tone at first. This will allow you to gauge a person’s reaction and demeanour;

- Be cautious of over-familiarity and your choice of words, expressions and humour. What you may regard as acceptable may cause offence to others. Also try to avoid using overly technical terms or jargon;

- Remember that you are acting as an agent of the Fire & Rescue Authority. Your approach should be calm and professional no matter how provoked. For you, the visit is work, not a personal matter;
- Be aware that sometimes responsible people/clients do get genuinely confused or do not understand. On the other hand, sometimes they blatantly lie, conceal information, or try to play one officer off against another (e.g. “the officer that came last year said this would be perfectly alright!”). Remember that your ultimate duty is to ensure that “relevant people” are not being put at risk from fire by the errors or omissions of the Responsible Person;

- Never be critical of another FRS Officers advice in front of a client. It will be seen as being inconsistent or demonstrating double standards, and may diminish confidence in both officers;

- Do not make statements that you cannot back up with facts, and do not make veiled threats about possible enforcement or other repercussions;

- Avoid confrontation and argument. Fire safety checks are not supposed to be that difficult. If a visit is heading in a confrontational direction the best advice is to withdraw from the visit and seek advice urgently.
Meeting Etiquette

As every visit will involve dealing with a wide range of different people, an understanding of etiquette and basic human behaviour in the context of such a visit is beneficial.

The following guidelines may be helpful:

- People will consciously and unconsciously begin to make their assessment of you at first sight. First impressions count. Present yourself in a smart and helpful manner;

- Be aware of personal body space. Do not get too physically close to a person, on the doorstep, across the desk, or during the visit;

- Be aware of people’s territorial domains. Do not dump coats, paperwork, etc. on a desk or chair, or take a seat without asking first. Behaving in such a thoughtless way can leave people quietly bristling;

- Be sensitive to, and observe body language and demeanour. Whilst this is a complex subject, most people can detect nervousness, irritation, impatience and similar emotions, from non-verbal communication;

- Try to develop active listening skills rather than just interrupting, or thinking of what to say as you wait for your turn to speak next. Sometimes Officers have been criticised for being distracted by filling in forms, or not really listening to what is being said;

- Be aware that the Responsible Person or their authorised representative can sometimes have other things going on in their lives which may be causing them to behave or react in a certain way.
Aggressive or distracted behaviour may be deliberate or intimidatory, or may be the result of stress, illness or some other factor;

- Try not to personalise problems by apportioning blame for failures and omissions. Wherever possible try to give people face-saving “escape routes” rather than backing them into a corner. They know who is at fault.

- Invite the Responsible Person or their authorised representative to suggest solutions to problems discovered. Try to steer them in the right direction to achieve a satisfactory resolution. They will be more enthusiastic and engaged if they believe it is all their own idea;

- Be aware that Responsible Person or their authorised representative can be manipulative too. They may try to involve you in their own conflicts, disputes and vendettas, trying to use you to further their own agenda.
Useful Websites:

Legislation.Gov.UK. Useful site to access legislation, including the Regulatory Reform (Fire Safety) Order 2005

Fire Safety in the Workplace – Government website – with links to the various guides
https://www.gov.uk/workplace-fire-safety-your-responsibilities

Fire Kills
http://campaigns.direct.gov.uk/firekills/

The Passive Fire Protection Federation
http://pfpf.org/index.html

The Health and Safety Executive
http://www.hse.gov.uk

British Automatic Fire Sprinkler Association
http://www.bafsa.org.uk/mission.php

Building Research Establishment: Fire suppression in buildings using water mist, fog or similar systems.
http://www.bre.co.uk/filelibrary/water_mist.pdf

Fire Industry Association
http://www.fia.uk.com

Institution of Fire Engineers
http://www.ife.org.uk
**Suggested Further Reading**


Protection Handbook

History of Mather and Platt

BS 5306 Part 8.
Fire extinguishing installations and equipment on premises

BS 5839 - Part 1
Fire detection and fire alarm systems for buildings - Code of Practice for system design, installation, commissioning and maintenance.

BS 5839 - Part 6
Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings.


BS 5266-1 Emergency lighting. Part 1: Code of practice for the emergency lighting of premises

Acknowledgements

With grateful thanks to the following people, businesses and organisations for assistance with the production of this handbook and kindly providing illustrations, advice and support:

Advanced Diesel Engineering Ltd, Pontefract
http://www.adeltd.co.uk/

Bolton Evening news for use of Top Storey Club photograph.

British Gypsum, Leicestershire.
http://www.british-gypsum.com/

Chemstore Environmental UK
http://www.chemstore.co.uk

Chubb Fire & Security
http://www.chubb.co.uk

Colt International Ltd.
http://www.coltinfo.co.uk

Cooper Lighting and Safety, Doncaster.
http://www.cooper-ls.com/

C.S Todd & Associates Ltd.
http://www.cstodd.co.uk

Detector Technologies Ltd
http://www.videosmokedetection.com/

Envirograph. Intumescent Systems Ltd.
http://www.envirograf.com
Fire Fighting Enterprises Ltd
http://www.ffeuk.com

Glulam Timber Systems Ltd. Avonmouth, Bristol;
http://www.glulam.co.uk
Hochiki Europe(UK) Ltd
http://www.hochikiuk.com

Irish Times for use of the Stardust Discothèque photograph.

Jessica Cox of Jessica Cox Motivational Services
http://www.rightfooted.com/

Job GmbH – Sprinkler bulb manufacturer.

Kingspan Group PLC
http://www.kingspan.com/kingspangroup/
Manchester Evening News for use of the Woolworths fire photograph.

Marcel Boschi - Historian of Mather & Platt and Grinnell.

Page Concrete & Steel Products, Crediton, Devon;
http://www.pageconcrete.co.uk/

Nigel Saunders & Paul Wood for Lakanal House photograph.
http://www.frpix.co.uk

Oasys Ltd.
http://www.oasys-software.com

Prysmian Cables and Systems Ltd
http://www.prysmian.co.uk
Protection Handbook

Rockwool Ltd, Bridgend.
http://www.rockwool.co.uk/home

Siemens UK
http://www.siemens.co.uk/en/index.htm

Simplex Grinnell
http://www.simplexgrinnell.com

Ultra Fire Group – Fire engineers and water mist specialists.
Pontefract http://www.ultrafiregroup.co.uk

Watermist Fire Suppression Systems Ltd
http://www.watermist.com/index.htm

Wolf Safety Lamp Company, Sheffield.
http://www.wolf-safety.co.uk/

Xtralis Ltd – Aspirating fire detection/VESDA
http://xtralis.com

Dr. Jim Marsden  CEng BEng CFIFireE (Director). Ignis Associates Ltd.
Consulting Fire Engineers

All the above accessed 2013.

With grateful thanks to the following persons who assisted with peer review and the development of the different versions of this handbook.

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**Amendments**

Version 12.1 – October 2013 Michelle Purchase  
Version 12.2 – January 2015 Brian Harvey  
Version 13.0 – April 2016 Brian Harvey  
Version 13.1 – July 2017 Brian Harvey  
Version 13.2 – March 2018 Brian Harvey
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