UNIT-2 Fire Risk Assessment

Learning Outcomes
By the end of this unit the learner will be able to:

Unit 2

Fire Risk Assessment

Legislation requires a suitable and sufficient fire risk assessment to be carried out by a responsible person (the employer or persons in control).

The FSO places responsibility for compliance on the 'responsible person'. Article 3 defines the responsible person as:

- the employer (for a workplace to any extent under the employer's control); or
- a person who has control of a premises in connection with them carrying out any 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 any trade, business or other undertaking.

As with assessments of risk from other hazards, the fire risk assessment should be based on the following approach:

Step 1 – identify the hazards.
Step 2 – identify people at risk.
Step 3 – evaluate, remove, reduce and protect from risk.
Step 4 – record, plan, inform, instruct and train.
Step 5 – review.

Step 1 Identify the hazards

24 The basic principles which follow are relevant to fire risk assessment in all circumstances. However, it is important to note that there will be different things to consider for new builds compared to the refurbishment of an existing building.

For a new build, your assessment will include its location and proximity to other buildings, the type of construction materials and methods. While completed buildings have the standards of fire protection required by Building Regulations, during construction and before final fire

protection is in place the building will be more vulnerable to fire. This vulnerability can often lead to the whole structure being involved in fire with resultant on- and off-site fire spread issues, eg the building could be timber framed and more vulnerable to fire before the external finishes are in place. This vulnerability needs to be taken into account early in the design process. In some situations the additional costs entailed in providing adequate controls might make it more cost effective to specify alternative methods or materials from the outset. For a refurbishment project it will be important to take into account, among other things, the age and construction of the premises, eg the building could have a relatively heavy fire load due to lath and plaster ceilings and walls, wooden panelling and floors. There may also have been changes to the fabric of the building that could have significant consequences in a fire.

For a fire to start, three things are needed:

- a source of ignition;
- fuel; and
- oxygen.

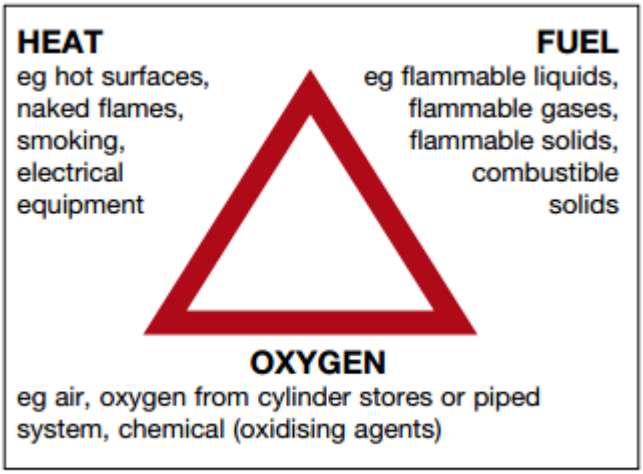


Figure 1 The three elements that combine to start a fire

If any one of these is missing a fire cannot start. Taking measures to avoid the three coming together will therefore reduce the chances of a fire occurring.

The remainder of this step will advise on how to identify potential ignition sources, the materials that might fuel a fire, and the oxygen supplies which will help it burn.

Identify sources of ignition

You can identify the potential ignition sources prior to and during the construction process by looking for possible sources of heat that could get hot enough to ignite material found on your site. These sources could include:

- smokers' material, eg cigarettes, matches and lighters;
- naked flames, eg gas- or liquid-fuelled open-flame equipment;
- those deliberately introduced (arson);
- bonfires;
- plant and equipment, eg fuel and vehicle exhausts;
- electrical – faulty or misused electrical equipment;
- poor electrical installations, eg overloads, heating from bunched cables and/or damaged cable;
- hot processes/hot work, eg welding by contractors;
- light fittings and lighting equipment, eg temporary lighting, halogen lamps too close to stored products;
- electrical, gas- or oil-fired heaters (fixed or portable), room heaters in temporary office accommodation or welfare cabins;
- heat sources, such as gas, electric, cooking equipment, microwaves;
- friction-generated heat from mechanical equipment such as disc cutters;
- static charge from mechanical equipment;
- use of oxy-fuel equipment;
- spontaneous ignition and self-heating, eg oil-soaked rags, paint scrapings; and/or
- lightning and refracted sunlight.

Identify sources of fuel

Anything that burns is fuel for a fire. Many materials which can burn have to be used during construction work. Reducing the quantity of material on site reduces the chances of fire occurring and limits the extent of any fire which should start. Stocks of high fire hazard material should be managed to balance production needs with the need to reduce the risk of fire. Limit the material present at worksites to what is needed for half a day or a single shift and return unused material to the stores when the work is finished. Where combustible or flammable materials have to be used, select the least combustible alternatives.

You need to look for the things that will burn and are in enough quantity to provide fuel for a fire or cause it to spread to another fuel source. Some of the most common fuels found on site include:

- components of the structure itself such as some composite panels and timber;
- stored/in-use building products such as composite panels and timber;
- rubbish;
- flammable liquids such as paints and varnishes;
- protective coverings;
- scaffold sheeting;
- volatile flammable substances such as paints, thinners;
- fuel for portable equipment;
- liquefied petroleum gas (LPG), eg bitumen boilers, temporary site accommodation and similar areas;
- acetylene;
- packaging materials;
- petrol disc cutters and other portable equipment;
- fall-arrest bags.

Identify sources of oxygen

The main source of oxygen for a fire is in the air around us. On construction sites this will be natural airflow through doors, windows and other openings. Wind or the 'chimney effect' can also cause increased oxygen to feed the fire.

Additional sources of oxygen can sometimes be found in site processes or materials used or stored on site such as oxidising agents; they can provide a fire with additional oxygen and so help it burn. These chemicals should have identification on their container (and COSHH/CHIP data sheet) by the manufacturer or supplier who can advise as to their safe use and storage,

Examples include:

- oxygen used in welding processes; and
- oxidising agents (which carry the symbol below).

Your checklist:

- Have you identified all potential ignition sources?
- Have you identified all potential fuel sources?
- Have you identified all potential sources of oxygen?
- Have you made a note of your findings?

Step 2 Identify people most at risk

As part of your fire risk assessment, you need to identify those at risk if there is a fire. To do this you need to be aware of where you have people working on site or people who are affected by your site, such as contractors, visiting dutyholders and members of the public in nearby premises etc. It is also important to look at those affected if the site is partially occupied. When parts of a completed refurbishment or new build are handed over to the client on a phased sequence it is important to ensure that all those who may be affected by fire in either the construction site or the occupied premises have been identified.

You must consider all the people who use or could be affected by your site, but you should pay particular attention to people who may be especially at risk such as:

- those who work alone, eg security staff;
- people who are in isolated areas, eg maintenance staff, staff on cranes and reach trucks;
- people who are unfamiliar with the site, eg new sub-contractors or visitors;
- people with language difficulties;
- young people;
- pregnant women;
- disabled people;
- other people in the vicinity of the premises; and
- those occupying adjacent buildings who may be at risk from radiated heat/fire spread.

If a fire does break out, it is most likely that the local fire and rescue service will attend your site. In implementing the findings of your fire risk assessment, and preparing your emergency plan, you should therefore consider the risks that fire fighters would face on your site in the event of a fire or other emergency.

Fires on construction sites can also cause the closure of roads and railways.

Your checklist:

- Have you identified who is at risk?
- Have you identified why they are at risk?
- Have you made a record of your findings?

Step 3 Evaluate, remove, reduce and protect from risk

Having identified the hazards in Step 1 and the people at risk in Step 2, you now need to take action to reduce the risks to an acceptable level. You should do this in two ways, by:

- reducing the risk of a fire occurring; and
- reducing the risks to people in the event of a fire.

Reducing the risk of a fire occurring

The way the site is managed may affect the precautions you need to put in place. You may not be the only one in control of the site – for example, during refurbishment work part of the site may remain occupied during the work. You may need to work with managing agents or building owners and, in multiple occupancy buildings, all those with some control must co-operate to reduce the risk to an acceptable level.

In general, fires start in one of three ways:

- accidentally, such as when smoking materials are not properly extinguished, or when lights are too close to combustibles;
- by act or omission, such as when electrical equipment is not properly maintained, or when combustibles are allowed to accumulate near to a heat source, or by storing LPG next to an electric fire or other source of heat; or

- deliberately, such as an arson attack involving setting fire to external rubbish skips placed too close to the building.

Look critically at your project and try to identify any accidents waiting to happen and any acts or omissions which might allow a fire to start. You should also look for any situation that may present an opportunity for an arsonist.

You should remove hazards where it is reasonably practicable to do so. If you cannot remove the hazards, you need to take reasonable steps to reduce them to an acceptable level. You should do this early in the planning process, well before the construction work starts. For example, in heavily built-up areas, where the risk to neighbouring properties has been identified as high, changing from a timber frame build method to one involving a lower risk from fire will significantly reduce the overall risk from the project. Designers can also specify that permanent fire protection such as stair enclosures should be constructed as early as possible to improve means of escape for those constructing the building. The early installation of fire mitigation methods such as fire detection and suppression systems will also reduce the risk.

Ensure that any actions you take to remove or reduce fire hazards are not substituted by other hazards. For example, if you replace a flammable substance with a toxic or corrosive one, you must consider whether this might cause harm to people in other ways.

Remove or reduce sources of ignition

There are various ways that you can reduce the risk caused by potential sources of ignition, for example:

- Wherever possible, replace a potential source with a safer alternative, for example, replace naked flame and radiant heaters with fixed convector heaters or other types of heaters with no red element.
- Conduct routine hot works, eg steel cutting, in a designated area away from combustible material and the main structure.
- Operate a safe smoking policy – allow smoking only in designated smoking areas and prohibit smoking elsewhere.
- Restrict the movement of and guard portable heating appliances.
- Separate ignition hazards and combustibles, eg ensure sufficient clear space between lights and combustibles, and consider building fire-resistant enclosures for hot work processes.
- Control, inspect and monitor ignition hazards, eg temporary lighting, halogen lamps, display lighting or lights too close to combustibles.

- Ensure electrical, mechanical and gas equipment is installed, used, maintained and protected in accordance with the manufacturer's instructions, including any equipment located in temporary accommodation.
- Strictly control hot processes/hot work by operating permit-to-work schemes.
- Check all areas where hot work (eg welding) has been carried out at regular intervals for 60 minutes after work has finished to ensure that no ignition has taken place and no smouldering or hot materials remain that may cause a fire.
- Ensure that no one carrying out work on gas fittings, which involves exposing pipes that contain or have contained flammable gas, use any source of ignition such as blow-lamps or hot-air guns.
- Take precautions to avoid arson.
- Turn off equipment when it is not attended or being used.
- Take action to avoid any parts of the site, and in particular storage areas, being vulnerable to arson or vandalism.
- Do not permit bonfires on site.

Remove or reduce sources of fuel

There are various ways that you can reduce the risks caused by materials and substances that burn, for example:

- Substitute with less flammable materials.
- Plan to reduce storage of combustible materials (eg just-in-time ordering).
- Keep stocks of flammable liquids and gases, in use in open areas, to a minimum.
- Keep flammable liquids and gases which are not in use in dedicated storage areas, externally, where only the appropriate staff are allowed to go, and keep the minimum required for the operation.
- Do not keep flammable solids, liquids and gases together.
- Keep areas containing flammable gases well ventilated, eg LPG cylinders should be kept outdoors in a secure cage.
- Remove or treat materials that are provided to protect finished goods.
- Develop a formal system for the control of combustible waste by ensuring that waste materials and rubbish are not allowed to build up and are carefully stored until properly disposed of, particularly at the end of the day, eg in lockable metal skips.
- Be aware of the changing flammability of materials as they are used.

Further guidance on removing and reducing hazards is given in Part 2.

Remove or reduce sources of oxygen

48 You can reduce the potential source of oxygen supplied to a fire by:

- in both new build and refurbishments, closing doors, windows and other openings not required for ventilation, particularly out of working hours;
- eliminating or, if not possible, reducing the amount of oxidising materials and not storing oxidising materials near or within any heat source or flammable materials;
- controlling the use and storage of oxygen cylinders, ensuring that they are not leaking, are not used to 'sweeten' the atmosphere, and that where they are located is adequately ventilated; and
- in the later stages of the project, considering shutting down ventilation systems that are not essential to the function of the premises.

Reducing the risk to people in the event of a fire

Having reduced the risk of a fire occurring to an acceptable level, you now need to consider how you will protect people in the event of a fire.

To evaluate the risk to people on your site you will need to understand the way fire can spread. Fire is spread by three methods: convection, conduction and radiation.

Convection – fire spread by convection is the most dangerous and causes the largest number of injuries and deaths. When fires start in enclosed spaces such as buildings, the smoke rising from the fire gets trapped by the ceiling and then spreads in all directions to form an ever-deepening layer over the entire room space. The smoke will pass through any holes or gaps in the walls, ceiling and floor into other parts of the building. The heat from the fire can get trapped in the building and the temperature rises.

Conduction – some materials, such as structural steel, pipe work and ducting can absorb heat and transmit it to the next room, where it can set fire to combustible items that are in contact with the heated material.

Radiation – radiation heats any solid it strikes in the same way as an electric bar heater heats a room. Any material close to a fire will absorb the heat until the item starts to smoulder and then burn.

The radiated heat from large construction site fires can ignite buildings many metres away.

Smoke produced by a fire also contains toxic gases which are harmful to people. A fire in a building with modern fittings and materials generates smoke that is thick and black, obscures vision, causes great difficulty in breathing and can block the escape routes. It is essential that the means of escape and other fire precautions are adequate to ensure that everyone can make their escape to a place of total safety before the fire and its effects can trap them in the building or on the site itself. In evaluating this risk to people, you will need to consider situations such as:

- fire starting on a lower floor affecting the only escape route for people on upper floors;
- fire starting in storage areas and affecting hazardous materials (such as gas cylinders);
- fire developing in an unoccupied area that people have to pass by to escape from the building;
- fire spreading extremely rapidly through the building because of combustible structural elements and/or large quantities of combustible goods;
- fire or smoke spreading through a building via routes such as vertical shafts, service ducts, ventilation systems, partially installed walls, partitions and ceilings;
- fire and smoke spreading through a building due to the incomplete structure or poor installation of fire precautions, eg fire doors not installed or incorrectly installed services penetrating fire walls;
- fire and smoke spreading through the building due to absent fire doors/ compartmentation or fire doors being wedged open; and
- fire spreading to adjacent buildings.

General fire precautions

In the event of a fire, people must be able to escape from it. The measures which you put in place to allow people to escape are called ‘general fire precautions’.

You will need to consider:

- escape routes and fire exits;
- fire-fighting equipment;
- fire detection;
- raising the alarm;
- making emergency plans; and
- limiting the spread of fire (compartmentation).

The general fire precautions needed will vary from site to site and during the construction process. Sometimes they will be very simple and other times much more complicated,

depending on the risks involved, but they all need to take account of the nature and size of the site, the number of people present and the nature of the work being done.

Your checklist.

- Have you removed or reduced sources of ignition?
- Have you removed or reduced sources of fuel?
- Have you removed or reduced sources of air or oxygen?
- Have you removed or reduced the risks to people if a fire occurs by:
  - considering the need for fire detection and for warning?
  - considering the need for firefighting equipment?
  - determining whether your escape routes are adequate?
  - determining whether your lighting and emergency lighting are adequate?
  - checking that you have adequate signs and notices?
  - regularly testing and maintaining safety equipment?
  - considering whether you need any other equipment or facilities?

Step 4 Record, plan, inform, instruct and train

In Step 4 there are four further elements of the risk assessment you should focus on to address the management of fire safety on site. In some sites with simple layouts this could be done as part of the day-to-day management.

However, as the sites get larger it may be necessary for a formal structure and written policy to be developed. Further guidance on managing fire safety can be found in Part 2.

Recording the significant findings and action taken

If you or your organisation employs five or more people you must record the significant findings of your fire risk assessment and the actions you have taken.

Significant findings should include details about the:

- fire hazards you have identified in Step 1 (you do not need to include trivial things like a small tin of solvent-based glue);
- actions you have taken or will take to remove or reduce the chance of a fire occurring (preventive measures);
- people who may be at risk, including those who may be affected in adjacent premises;

- actions you have taken or will take to reduce the risk to people from the spread of fire and smoke;
- general fire precautions, ie escape routes and fire exits, fire-fighting equipment and raising the alarm;
- actions people need to take in case of fire, including details of any people nominated to carry out a particular function (your emergency plan); and
- information, instruction and training you have identified that people need and how it will be given.

You may also wish to record discussions you have had with staff or staff representatives (including trade unions).

Even where you are not required to record the significant findings, it is good practice to do so. On some simple sites, record keeping may be no more than a few sheets of paper (possibly forming part of a health and safety folder) containing details of significant findings, any action taken and a copy of the emergency plan.

The record could take the form of a simple list which may be supported by a simple plan of the site. On more complex builds, it is best to keep a dedicated record including details of significant findings, any action taken, a copy of the emergency plan, maintenance of fire-protection equipment and training. There is no one 'correct' format specified for this.

You must be able to satisfy the enforcing authority, if called upon to do so, that you have carried out a suitable and sufficient fire risk assessment. Keeping records will help you do this and will also form the basis of your subsequent reviews. If you keep records, you do not need to record all the details, only those that are significant and the action you have taken. It might be helpful to include drawings/ illustrations. This can also help you check your fire precautions as part of your ongoing review.

The findings of your fire risk assessment will help you to develop your emergency plan; the instruction, information and training you need to provide; the co-operation and co-ordination arrangements you may need to have with other responsible people; and the arrangements for maintenance and testing of the fire precautions. If you are required to record the significant findings of your fire risk assessment then these arrangements must also be recorded.

Your checklist:

- Have you recorded the significant findings of your assessment?
- Have you recorded what you have done to remove or reduce the risk?
- Are your records available for inspection by the enforcing authority?

Emergency plans

Your emergency plan should be based on the outcome of your fire risk assessment and be available for your workers, contractors, sub-contractors and their representatives (where appointed) and the enforcing authority. They should be produced before the work begins and any control measures identified should be in place from the start of the work.

(This guidance concentrates on fire. However, there may be other problems, such as flooding in excavations, tunnels, work near the sea or rivers, waterworks etc, or risk from asphyxiation or toxic gases. These should be integrated within fire procedures.)

The purpose of an emergency plan is to make sure that the physical measures will work effectively if they are ever needed and to ensure that the people (including those whose first language is not English or who have poor reading skills) on your site know what to do if there is a fire and that the premises can be safely evacuated.

Some emergencies may only require partial evacuation, eg where a series of separate structures are present on the site. Careful thought needs to be given to ensuring that the emergency plans are appropriate and capable of achieving the desired goal. Where whole-structure involvement is a possibility then the emergency plans should include a consideration of the occupants of adjacent premises.

On existing occupied sites, liaise and agree emergency procedures with the other occupiers. Ensure that the means are in place to let each other know straight away if an emergency does arise. If simultaneous evacuation is needed, make sure the escape routes are of sufficient capacity to achieve this.

Inform, instruct, co-operate and co-ordinate

You must give clear and relevant information and appropriate instructions to people on your site, such as sub-contractors (and their employers) and visitors, about how to prevent fires and what they should do if there is a fire.

The information and instruction you give should be based on your emergency plan and must include:

- the significant findings from your fire risk assessment;
- the measures that you have put in place to reduce the risk;
- what personnel should do if there is a fire;
- the identity of people you have nominated with responsibilities for fire safety; and
- any special arrangements for serious and imminent danger to persons from fire.

If necessary, you must also co-operate and co-ordinate with other responsible people who use any part of the site/premises.

Your checklist:

- Have your staff received any fire safety training?
- Are employees aware of specific tasks if there is a fire?
- Are you maintaining a record of training sessions?
- Do you carry out joint training and fire drills in multi-occupied buildings?
- If you use or store hazardous or explosive substances have your staff received appropriate training?
- Have you carried out a fire drill recently?

Step 5 Review

You should monitor what you are doing to implement the fire risk assessment to assess how effectively the risk is being controlled.

Because sites change rapidly, and often the workforce is transient, you need to ensure the risk assessment reflects these changes and the control measures necessary. You should consider the potential risk of any significant change before it is introduced.

Reasons for review could include:

- changes to work activities or the way that you organise them, including the introduction of new equipment;
- progression through the various stages of construction, eg alterations to the building, including the internal layout;
- the introduction, change of use or increase in the storage of hazardous substances;
- the failure of fire precautions, eg fire-detection and alarm systems;
- significant changes to types and quantities and/or methods of storage of goods; and a significant increase in the number of people present.

Do not amend your assessment for every trivial change, but if a change introduces new hazards, you should consider them and, if significant, do whatever you need to do to keep the risks under control. In any case, you should keep your assessment under review to make sure that the precautions are still working effectively.

If a fire or ‘near miss’ occurs, this could indicate that your existing assessment may be inadequate and you should carry out a re-assessment. It is good practice to identify the cause of any incident and then review and, if necessary, revise your fire risk assessment in the light of this.

Records of testing, maintenance and training etc are useful aids in a review process.

Detailed Guidance on Fire Risk Assessment and Fire Precautions

There are two ways of addressing fire in construction:

- prevent it happening in the first place (process fire safety); and
- prepare for and deal with the consequences if it does happen (general fire precautions, GFP).

Prevention is always better than cure, but both are necessary for construction fire safety.

The precautionary measures needed depend on the risks involved. However big the construction project, a risk assessment will always be required. In some cases only simple assessments will be required, but in others much more complicated issues will need to be decided. Ask the question: 'If somebody asked us to justify what we've done, could we really do it or would we just be guessing?'

Reducing ignition sources

Smoking

In accordance with current UK legislation, a 'no smoking' policy must be established. Any designated safe open air locations where smoking is allowed should be of a low fire risk design, away from any combustible or flammable materials and provided with metal ashtrays filled with sand.

For very high-risk sites the potential for a fire to start from smoking is significantly increased, therefore the controls and policing should reflect the risk.

Bring the smoking rules to the attention of all workers and visitors to the site. Display the appropriate signs, particularly in high-risk or communal areas such as canteens and site access points.

Plant and equipment

Plant and equipment should be appropriate for the task and consideration should be given to the area where it is sited (eg it may be acceptable to use a small generator in an open, well-ventilated building constructed of non-combustible materials; however, this would not be appropriate in a basement or enclosed space or an unprotected, framed construction such as timber).

Consideration should also be given to the storage of plant and equipment in relation to fire risk. Select plant, both electrical and engine driven, to match the demands placed upon it to prevent overheating during use, especially in dusty conditions.

Maintain all plant properly and, in particular, air filters and intakes should be regularly cleaned in dusty conditions. Ensure that air intakes are positioned so that air is free from flammable gases and vapours.

Operating and refuelling (especially with petrol) should not take place within a confined space; no refuelling on scaffold or escape routes, it should be in the open air or in well-ventilated spaces away from ignition sources. Bulk flammable liquid storage tanks should be bunded to current standards.

The use of portable petrol-fuelled generators indoors, or in partially enclosed areas to provide a power source for heating, lighting and other equipment, can put operators at risk of serious illness and death from carbon monoxide (CO) poisoning.

This hazard is present from the exhaust fumes of any internal combustion engine and care needs to be taken to avoid the use of other equipment such as disc cutters, chain saws, floor polishers and pressure washers.

Employers, operators, consumers and others should be aware of the hazard and take the following precautionary measures:

■■ Do not operate petrol-fuelled generators or tools indoors or in poorly ventilated areas. Even apparently well-ventilated locations such as partially open temporary enclosures can allow the accumulation of potentially lethal concentrations.
■■ Advise users to read and adhere to the safety instructions supplied with the equipment.
■■ Consider substituting other types of equipment powered by mains electricity, battery or compressed air if they are available and can be used safely.
■■ Recognise potential sources and symptoms of carbon monoxide poisoning.
■■ Design and label equipment for safe operation.

Recharging arrangements for vehicles or plant should be considered; for example, charging batteries in close proximity to ignition sources can cause fire.

Temporary lights can easily become an ignition source if broken or abused. Ideally, lamps should be securely fastened to a solid backing (see Figure 2). If they are mounted on tripods, make sure that the tripod cannot be dislodged or overturned. Make sure that electrical equipment is not inadvertently covered and that due care is taken in positioning, especially

halogen lamps and heaters, to ensure that they cannot ignite any combustible material nearby, or the structure itself.

Protect plant and equipment when used in areas where a potentially flammable atmosphere may occur, such as in LPG, highly flammable liquids (HFLs) storage areas and/or paint spraying or floor laying with HFLs. Only use electrical equipment that is certified as constructed to a suitable standard, eg BS EN Standards harmonised under ATEX 94/9/EC or an equivalent explosion protection standard.

Equipment that is not explosion protected should be kept a safe distance away, usually at least 4 m from any areas where there is a risk of ignition. Where explosive atmospheres might occur, the workplace has to be classified into hazardous areas (zones) and the right category of explosion-protected equipment has to be used in such zones. More detailed advice on zoning is contained in BS EN 60079–10:1996 and HSE guidance note HSG140 *The safe use and handling of flammable liquids*.

Use of oxy-fuel equipment

Workers should be competent in the use of oxy-fuel equipment, understand and follow appropriate work practices.

Provision and maintenance of the correct equipment are key factors in preventing incidents. Detailed guidance is given in HSE guidance note HSG139 *The safe use of compressed gases in welding, flame cutting and allied processes*, and in the British Compressed Gases Association Code of Practice No 7,4 but the following precautions address more common problems:

Figure 2 Festoon lighting: an incorrect fixing creates a potential fire risk

Regulators and hoses should be of a recognised standard, eg BS EN ISO 2503:2009 and BS EN 559:1994, respectively.

- To avoid confusion hoses should be colour coded as:
  - blue – oxygen;
  - red – acetylene; and
  - orange – propane.
- Non-return valves at the torch (blowpipe) inlet and flashback arresters at the pressure outlet from the gas cylinders should be provided on both gas lines. All such devices should be to an appropriate standard, such as BS EN 730:2002.
- Use proprietary hoses with properly made hose end connections. Worm drive fasteners are not recommended.
- Make sure that oil or grease do not contaminate the oxygen supply. Only use components that have been specially cleaned and supplied for oxygen use.
- Always check equipment visually for damage before use, especially the hoses. Any badly damaged or suspect hoses should be discarded from use. When you have assembled the equipment, always check for leaks by applying a soap solution around joints and watching for bubbles.

- Gas cylinders should be secured in an upright position. Hose length should be kept to a minimum. This reduces the likelihood of damage and should help to ensure that the hose is not damaged by the hot work.
- Nominally empty drums should not be used as supports for hot work activities. 100 The legal obligations associated with the use of oxy-fuel equipment are detailed in the DSEAR ACOP L137 – *Safe maintenance, repair and cleaning procedures*.5

Permit-to-work (PTW) systems

All hot work generating heat sparks or flames can cause a fire. To avoid this, PTW systems should be considered. Where hot work is not carried out often, and where the risk of fire is low, the need for formal systems of management control is less. However, as the amount of hot work and the risks associated with it increases, the need for formal PTW systems increases. They are particularly useful where there are numerous hot work operations taking place and where there is a lot of combustible material present, both incidentally and as part of the building structure.

PTW systems are formal management documents. They should only be issued by those with clearly assigned authority to do so and the requirements stated in them must be complied with before the permit is issued and the work covered by it is undertaken. Individual PTW systems should relate to clearly defined individual pieces of work. Do not use PTW documents as blanket authorisations to carry out hot work anywhere on the site at any time; they should only be issued just prior to intended hot work duty and end once the activity at that location and time has finished. (More general standards for site-wide hot work can be set out in site rules.)

Further information and legal obligations on Systems of Work and Permits-to-Work are detailed in DSEAR ACOP L137 and HSE leaflet INDG98 *Permit-to-work systems*.

PTW systems should normally include:

- the location and nature of the hot work intended;
- the proposed time and duration of the work;
- the limits of time for which the permit is valid; and
- the person in direct control of the work.

Precautions to be taken and reflected in the PTW before, during and after the work include:

- clearing the surrounding area of all loose combustible material;
- checking for combustible material on both sides of a wall or partition, where work takes place only on one side;

- having suitable extinguishers at hand and a careful watch maintained for fire during the work and following completion;
- protecting combustible material which cannot be cleared;
- examining the hot work area thoroughly for some time after the work has finished (typically this will be at least an hour, but ignition can sometimes occur much later than this – inform the night security guards where hot work has been going on and ask them to check these areas); and
- in view of the potential risk, it is a sensible precaution for all hot work to stop by a safe period before the end of the day.

You may not need a fully-documented PTW system where the risks arising from hot work are low. However, precautions such as having a fire extinguisher are still required. Site rules are an effective means of making these precautions clear to those carrying out such work.

Electrical installations

Electrical installations, especially temporary ones, should be of sufficient capacity for the intended use and designed, installed, inspected and maintained by competent personnel. The installation should meet BS 7671: 2008 requirements for electrical installations, which includes a special section on construction sites. Do not allow ad hoc additions or alterations to the electrical installation by personnel who are not competent.

Some common electrical faults posing fire risks include:

- use of flat twin and earth cable as extension leads instead of suitable flexible cable;
- overloading of sockets in site accommodation;
- cable laid in or near combustible material, frequently in roof and ceiling voids;
- accumulation of rubbish against distribution boards poses similar fire risks and often occurs when installations are located in quiet parts of the site;
- intentional defeating of safety devices, such as fuses or circuit breakers;
- mechanical damage to cables, often as a result of inappropriate routeing of cables;
- makeshift cable joints made without correct proprietary connectors; and/or
- use of non heat-resistant glass or broken glass cover over a halogen lamp (poor heat-resisting glass covers have been known to ignite flammable vapours being emitted from a freshly applied solvent-based covering laid on to floors).

The proper use of electrical safety devices, such as residual current devices (RCDs), can reduce the risks of fire arising from electrical faults. However, they do not substitute for properly designed, installed, inspected and maintained electrical installations under the supervision of an electrically competent person.

In order to design and install a system which is safe, with adequate capacity, those responsible need to be informed about its likely use. Electrical systems need to be periodically checked to ensure that they remain safe and free from damage or deterioration. They should also be checked before any addition, extension or modification is carried out. On most sites, and particularly larger ones, this will require some form of systematic electrical inspection and maintenance regime.

Electrical equipment should meet standards that reflect the adverse conditions on most construction sites. Guidance regarding site electrical safety and periodic checks can be found in HSG141 *Electrical safety on construction sites*.

Bonfires

The burning of any vegetation or rubbish on site should be avoided unless absolutely necessary, and should only be considered in very limited situations such as site clearance for major road construction.

There is environmental legislation governing the rare circumstances where site burning may be permitted and contractors **must** check with clients, CDMC when notifiable, local authorities and the Environment Agency (the Scottish Environment Protection Agency, SEPA, regulate environment issues in Scotland) before contemplating any site burning.

If, under exceptional circumstances, site burning is permitted, it must be subject to a fire risk assessment and be controlled by a permit system. The following rules **must** be built into the permit system.

Prior approval and necessary permits **must** be obtained from all of the relevant authorities:

Only light fires, on an open site, on designated ground and far enough removed so that there is no risk of setting adjoining material, storage areas or structures alight.

- Large open bonfires can easily get out of control. Limit the amount burnt in one go to what can be dealt with in an incinerator, eg a properly designer incinerator or a 50 gallon spent oil drum which has been properly cleaned of flammable residues and provided with ventilation holes may be used in a controlled manner for this purpose.
- Never leave fires unattended until they are completely out, damping down if necessary.

- Attendants should have the correct fire extinguishers or other suitable equipment to hand.
- Material should be checked for dangerous items, such as empty cylinders, aerosol cans and flammable substances, before it is brought to the fire.
- Do not light fires on windy days.
- Do not site bonfires where flames, smoke and any air-borne debris might affect overhead electrical lines.

Petrol or other similar accelerants should **never** be used to start or fuel any fire. Use paper or similar kindling instead to start bonfires.

Arson and site security

Trespassers on site may deliberately or accidentally start a fire. Arson is a real, substantial problem and risk on all sites, particularly where there are trespassers.

Measures should be in place to prevent unauthorised access, especially by children. Care is needed to ensure that no gaps develop in the fencing/hoarding around the site.

Securely store (or if necessary remove) flammable liquids, LPG and other combustible materials while the site is closed.

Some sites may be particularly vulnerable to arson, especially those with a high fire loading or in localities with a known history of vandalism and arson, or where protective hoarding is not possible. In such cases, additional security measures beyond a perimeter fence should be considered, for instance:

- regular out-of-hours security patrols or a permanent security presence;
- security lighting;
- liaison with the local police force; and/or
- closed circuit television monitoring (CCTV).
  (Skips are often a target and their vulnerability should be considered.)

Security staff need to be alert to the possibility of detecting fire and know what to do if they discover it.

Arson is sometimes thought to be committed by site employees, eg unexplained skip fires. Site managers and site security staff should be aware of this potential and the need to be alert for signs of it during their inspections.

Reducing potential fuel sources

Dangerous substances can put people's safety at risk from fire and explosion. Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) put duties on employers and

the self-employed to protect people from risks to their safety from fires, explosions and similar events in the workplace; this includes members of the public who may be put at risk by work activity. Employers must:

- find out what dangerous substances are in their workplace and what the fire and explosion risks are;
- put control measures in place to either remove those risks or, where this is not possible, control them;
- put controls in place to reduce the effects of any incidents involving dangerous substances;
- prepare plans and procedures to deal with accidents, incidents and emergencies involving dangerous substances;
- make sure employees are properly informed about and trained to control or deal with the risks from the dangerous substances; and
- identify and classify areas of the workplace where explosive atmospheres may occur and avoid ignition sources (from unprotected equipment, for example) in those areas.

Reducing the amount of combustible material

Many materials which can burn have to be used during construction work (designers should consider potential fuel sources and design out if reasonably practicable). The risk of fire decreases as such material is reduced and the smaller any fire will be. There has to be enough material at hand to do the work, but this needs to be balanced against the need to reduce the risk of fire. Limit the material present at worksites to what is needed for half a day or a single shift and return unused material to the stores when the work is finished. Where combustible or flammable materials have to be used, select the least flammable alternatives.

Where the structure itself is flammable special considerations may be necessary to reduce the combustible material likely to be involved. This can include, for example, compartmentation into smaller volumes and fire-retardant treatment.

The amount of material kept on site, which can burn, should be minimised. The need to store such material varies greatly during the life of a site, but try to avoid stockpiling it unless it really is necessary. This can significantly reduce the fire loading and ease congestion on the site.

The changing flammability of materials as they are used

Construction work can alter the flammability of substances, including nominally flame-retardant ones. For instance, when worked on, solid materials (even nominally fire-resisting ones) produce dust, crumbs or other fine material which are always more easily ignited than the bulk material. Remember this when planning construction fire precautions, especially when hot work is used.

General requirements for storage of all combustible materials

Ideally, combustible materials need to be stored outside buildings under construction, especially volatile flammable materials such as LPG. If combustible materials are stored inside buildings, they need to be kept in an area where the safety of people (on and adjacent to the site) is not threatened in the case of a fire. For example, do not put paint stores next to emergency exits or under any means of escape, eg steps/staircases.

Access to stores should be controlled so that material does not become dispersed haphazardly around the site.

If storage outside the structure is not possible, internal stores need to be arranged to limit the spread of fire. Internal stores, especially in more enclosed buildings, may need to be separated from the rest of the structure by a partition providing at least 30 minutes' fire resistance. Good quality plasterboard will usually achieve this and can be very useful for constructing small internal stores. Doors should be fire resisting and self-closing

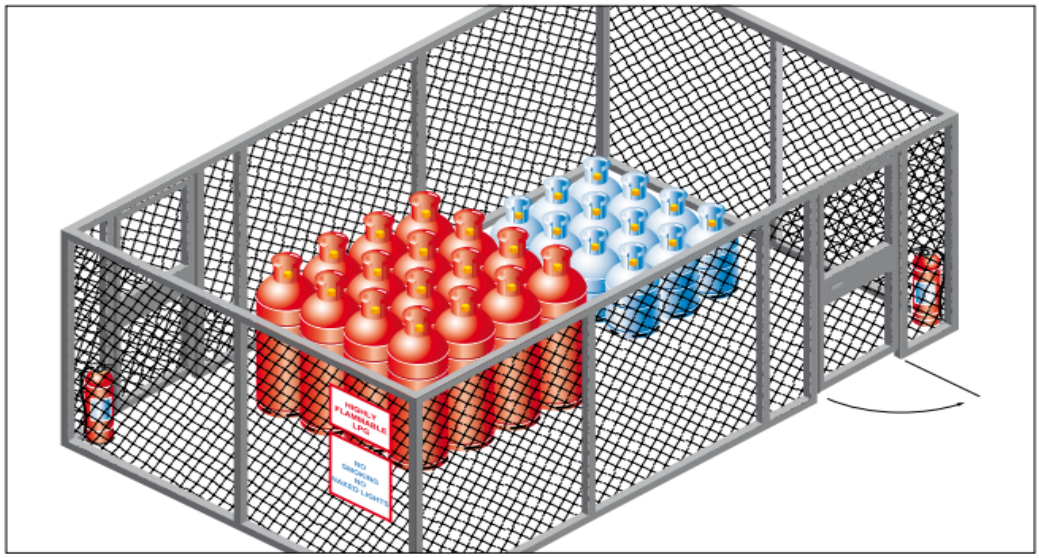


Figure 4 When large amounts of LPG are stored, provide purpose-built, secure accommodation for it

Storage of more volatile flammable materials

Extra precautions are needed with highly flammable liquids with flashpoints below 32ºC, eg with many solvents, petrol, adhesives, LPG, flammable gas and oxygen cylinders, especially when stored internally (see Figure 4).

Good ventilation is needed to prevent dangerous levels of gases or vapours accumulating in internal stores. High and low openings in the external wall help to achieve this. The openings should not ventilate into the surrounding structure. Openings representing 1% of the total floor

and wall area are sufficient for flammable liquid storage. For flammable gas and oxygen cylinders, openings representing 2.5% of the total floor and wall area are usually sufficient.

Locate external stores in the open air, in a well-ventilated area that is shaded from the sun. LPG cylinders and tanks should be stored away from construction activities and ignition sources, the separation distance varying dependent on quantity stored – contact your supplier or refer to the UKLPG Code of Practice 7 for guidance. Highly flammable liquids guidance can be found in HSG 51 *The storage of flammable liquids in containers*8 (see also paragraph 141 below).

External stores should be enclosed by a 1.8 m high-wire mesh fence for security if the above cannot be achieved. This is:

- unless the building itself is fire resisting (there should be a fire-resistant partition between the store and the building. This fire-resisting partition should protect the building to a distance of 3 m each side of the store and to a height of 9 m above it. The fire protection could be a separate partition or the same area of the wall of the building constructed with fire-resisting material, glazing and doors); and/or
- unless seal drains and seal excavations are present, or a spillage retention wall is placed around the store.

Volatile flammable materials may need to be stored inside buildings for security reasons. Any building used for this purpose should be separate from that undergoing construction work. Such a building does not need to be fire resisting if it is in a safe location. However, it should be of a generally non-combustible construction and be provided with ventilation.

Whatever form the storage area takes, unless it is small enough to ensure that no one will be trapped in the event of a fire, it should have at least two exits, both unlocked whenever anyone is in it. (A single exit may be adequate when the travel distance does not exceed 12 m.) Lock the storage area whenever it is unattended.

Small quantities of LPG (ie less than 300 kg) may be kept in a lockable wire cage with only one exit. Clearly mark the cage and situate it away from temporary site accommodation, boundaries, excavations or other features.

Small quantities (for example up to 50 litres) of flammable materials such as paints, solvents, petrol and adhesives can be stored in lockable steel chests.

Do not store anything other than flammable materials in flammable material stores. Avoid accidental spillage inside the store by banning the decanting of liquids and the refuelling of petrol-driven equipment within it. Flammable liquids, solids and gases should be kept in separate stores.

Petrol-driven equipment should be refuelled in designated safe areas that are outside and well ventilated. Petrol cans should not be stored or used inside the structure or on escape routes.

Never store LPG cylinders in unventilated metal boxes or temporary accommodation. If there is a leak, gas will build up to a dangerous level and may explode when ignited.

Always store oxygen cylinders separately from cylinders of flammable gases such as LPG and acetylene.

For more information on the storage of LPG, read UKLPG Code of Practice 7 *Storage of full and empty LPG cylinders and cartridges*. For information on the storage of flammable liquids, read HSE guidance note HSG51 *The storage of flammable liquids in containers*.

Handling more volatile flammable substances

Flammable liquids, especially highly flammable liquids, need careful handling.

Practices to limit the likelihood of spills and the release of flammable vapour concentrations are required. In particular:

- provide drip trays to contain spillage during dispensing and decanting;
- carry out operations in well-ventilated areas;
- use proper handling aids when dispensing from large containers;
- keep flammable liquids in secure closed-top containers during conveyance;
- dispose of contaminated rags safely – containers should be of metal construction and be suitably covered with a metal lid; and
- ensure that any clothing becoming soaked in flammable liquids is removed and replaced with fresh clothing.

Further information is given in HSE guidance note HSG140 *The safe use and handling of flammable liquids*.

Liquid Petroleum Gas

LPG is widely used across the entire range of construction activities. It is probably the largest single contributor to the risk of fire on construction sites and has been involved in many serious fires and explosions, particularly where there have been leaks in temporary site accommodation.

Precautions for all uses of LPG

The following are important precautions.

- Minimise the storage of LPG on site; LPG cylinders are readily available and in most cases can be delivered without significant delay.

- Turn off cylinder valves before connecting or disconnecting any equipment. Hoses should never be kinked during disconnection, connection or at any other time. This damages the hose and can easily lead to accidental release of LPG.
- Check LPG cylinders and associated fittings before use. If there are any signs of leaking or damage, do not use them. While they may be detected by smell or the hiss of escaping gas, soapy water is a more reliable method of checking for leaks.
- During use, secure cylinders in an upright position unless designed to be used in another position, eg on an LPG-fuelled forklift truck. If there is any smell of gas during use, turn off the main cylinder valve immediately and make sure the cause is investigated, determined and put right.
- Many appliances will be provided with recommended lighting instructions and these should be followed. In general, the appliance valve should be closed before the cylinder valve is opened. If the lighting procedure fails, gas should be allowed to disperse before attempting to relight.
- Handle cylinders carefully. Mishandling of cylinders can damage valves and repeated abuse can also lead to serious structural weakness. 146 LPG appliances brought onto site need to be constructed, installed, used and maintained to appropriate standards. For example, there are several relevant British

Standards including:

- BSEN 521: 1998;
- BSEN 1596: 1998;
- BS 5482: Part 2, 1997;
- BS 7261: 1990; and
- BS 5440: Parts 1 & 2, 2000.

When purchasing LPG equipment, make sure it complies with these or other equivalent standards.

Properly install all appliances and keep them maintained by those who are competent to do so. Ensure that fixed installations are installed and maintained by a registered gas engineer. Adequate ventilation is needed when LPG appliances are used. Where there are fixed installations inside buildings, permanent ventilation openings are required which need to be kept clear.

Unless the flame can always be seen by someone in attendance whenever the appliance is used, fit a flame-failure device.

Use appliances in accordance with the manufacturer’s instructions. Ensure that the instruction booklet is available to the user or that a notice is placed on the appliance.

Different appliances are designed to work at different inlet pressures. The correct gas regulator must always be used with the appliance concerned. Check with the manufacturer or a registered gas engineer if there is any doubt.

Ensure that replacement hoses are of an appropriate standard, such as BS 3212: 1991, and that they are properly secured to the equipment with appropriate clips. Proprietary crimped clips or swaged fittings should be used on hoses that have an internal diameter of greater than 8 mm and an operating pressure greater than 50 mbar. Properly fitted worm drives or Jubilee clips may be applicable on smaller bore hoses operating at pressures of less than 50 mbar. (See UKLPG User Information Sheet 017.10)

Precautions for some particular uses of LPG/flammable gases

The following are important precautions during common LPG applications.

Bitumen boilers

- LPG cylinders should be kept at least 3 m from the burner or boiler, or protected by an appropriate heat shield. Where the cylinders are remote they should be sited clear of traffic to prevent damage to the hose (which should be suitably robust; steel reinforced braid, for example).
- Never leave boilers unattended while the burner is alight.
- Do not tow or move boilers while the burner is alight.
- When possible, avoid taking tar boilers and similar equipment onto roofs. If this cannot be avoided they should be placed on a non-combustible insulating base to protect the roof from ignition. Equipment should be under the supervision of an experienced operator and sited where spillages can be easily controlled.
- Appropriate fire-fighting equipment should be located nearby.

Guidance can be found in the UKLPG Code of Practice 4 – *Safe and satisfactory operation of propane fired thermoplastic and bitumen boilers, mastic asphalt cauldrons/mixers, hand tools and similar equipment*.

Risk assessments should include usage instructions/precautions for the warm air heaters often used to dry out properties.

Temporary site accommodation and similar areas

- If equipment leaks or heater flames fail, flammable vapour is able to build up inside temporary site accommodation and can result in a fire or explosion. It is especially dangerous if vapour accumulates out of hours.

- Temporary site accommodation needs to be adequately ventilated at high and low levels and heaters should be properly maintained. Make sure heaters have flame failure devices incorporated so that the gas supply is shut off if the flame fails.
- Where cylinders are an integral part of the appliance (eg cabinet heaters) they may be kept inside the temporary site accommodation, but where they are separate from the heater, keep them outside the temporary site accommodation and connected to the heater by the shortest practicable length of suitable hose or piping.
- In both cases, the fuel supply must be turned off at the appliance and the cylinder after use (and especially when the site closes overnight or at weekends). Always keep heaters clear of obstruction, eg clothing. ■■ Do an end-of-day check.

Transport of LPG

Use open vehicles to transport cylinders upright. Ideally, LPG should not be carried on vehicles with other flammable materials, eg paints, solvents etc. If this is unavoidable, the other materials should be kept in a closed-steel chest or box and well away from the cylinders.

Drivers carrying small loads of LPG of less than 333 kg are exempt from certain requirements of the Carriage Regulations (CDG 2009 and ADR). For these quantities the legal obligations are to:

- provide general driver training;
- carry one 2 kg dry powder fire extinguisher; and
- stow the LPG cylinders properly.

Where quantities in excess of 333 kg are carried the full requirements of the Carriage Regulations apply and this includes, for example:

- appointing a Dangerous Goods Safety Adviser;
- providing written instructions for the driver;
- displaying Orange Plates;
- carrying at least two 2 kg dry powder fire extinguishers;
- providing specific driver training; and
- providing specific vehicle requirements.

For further information see the HSE website at www.hse.gov.uk/cdg/index.htm and the UKLPG Code of Practice No 27.12

Acetylene

Acetylene is a flammable gas that at elevated temperatures and pressures becomes unstable and liable to spontaneous decomposition, particularly following impact of the cylinder. Because of these properties, acetylene cylinders involved in a fire can constitute a serious explosion hazard.

In these circumstances, fire service safe working practices include the establishment of a hazard zone of up to 200 m around the incident and leaving the cylinders involved undisturbed for up to 24 hours or more prior to removal. All activities in the designated hazard zone have to cease and the area is evacuated, with significant implications for the businesses operating in the area.

Therefore, it is important that the use of acetylene on construction sites be eliminated wherever reasonably practicable and alternative methods of cutting and welding be adopted. Some sites have banned the use of acetylene and it is important checks are made before taking it on site.

Less hazardous alternatives include cold-cutting techniques or the use of propane of methyl acetylene propadiene propane (MAPP) as the fuel gas.

Where there is no alternative to the use of acetylene:

- its presence must be minimised and the number of spare cylinders stored on site should be kept to the absolute minimum;
- acetylene cylinders should be removed from the workplace and returned to the storage area as soon as the period of work has been completed. The cylinders should be removed from the site as soon as their use is complete;
- gas cylinders must be secured in a vertical position, preferably by mounting on purpose-built trolleys, and fitted with a regulator and flashback arrester;
- equipment and hoses used with oxyacetylene and similar equipment should be in good condition, set up in accordance with the manufacturer's instructions and be subject to a visual inspection before each period of use; and
- gas welding and cutting procedures should only be carried out by a competent person or under the supervision of trained personnel.

Nominally empty cylinders still contain solvent and acetylene and should be treated in the same way as full cylinders. They should be kept in safe areas and returned to the supplier as soon as possible.

Protective coverings

Protective coverings are a common feature during fit-out stages where final fixtures, such as doors, handrails, floor coverings and panels, need to be protected against damage. Such coverings can be a substantial contribution to the overall fire load in circumstances where ignition sources are common.

Particular risks occur where protective coverings are used to protect features in fire escape stairways – this should be avoided. The risk can be reduced by using covering materials that are flame retardant.

Those complying with the Loss Prevention Standard LPS1207 satisfy flame-retardant criteria. Though they have greater fire-retardant properties they can still burn and, therefore, at least one fire escape stairway should be kept free of such protective coverings.

Risks arising from protective coverings can be reduced by:

- installing vulnerable features needing protection as late as possible in the fit-out stage; and
- ensuring that the coverings are to flame retardant specifications wherever possible. This may require liaison with suppliers of vulnerable items and/ or protective coverings.

Scaffold sheeting

In practice, external scaffolds may prove a valuable escape route in the event of fire, even if they are not specifically intended for this purpose (see Figure 5). If scaffolds are sheeted with flammable materials, not only do they contribute to the fire loading, but it would also be unacceptable to rely on them as a significant means of escape. If such reliance is anticipated, scaffold sheeting should be to flame-retardant standards and this is recommended in other circumstances as well. (Sheeting complying with the Loss Prevention Standard LPS 1215 satisfies flame-retardant criteria.) If major or sole reliance on escape via a scaffold during fire is anticipated, the need for and extent of sheeting needs to be carefully considered. Where possible, it should be incomplete in the vicinity of escape ladders and stairs. Not only does this reduce the fire load, it also minimizes smoke logging in escape routes and eases fire service access.

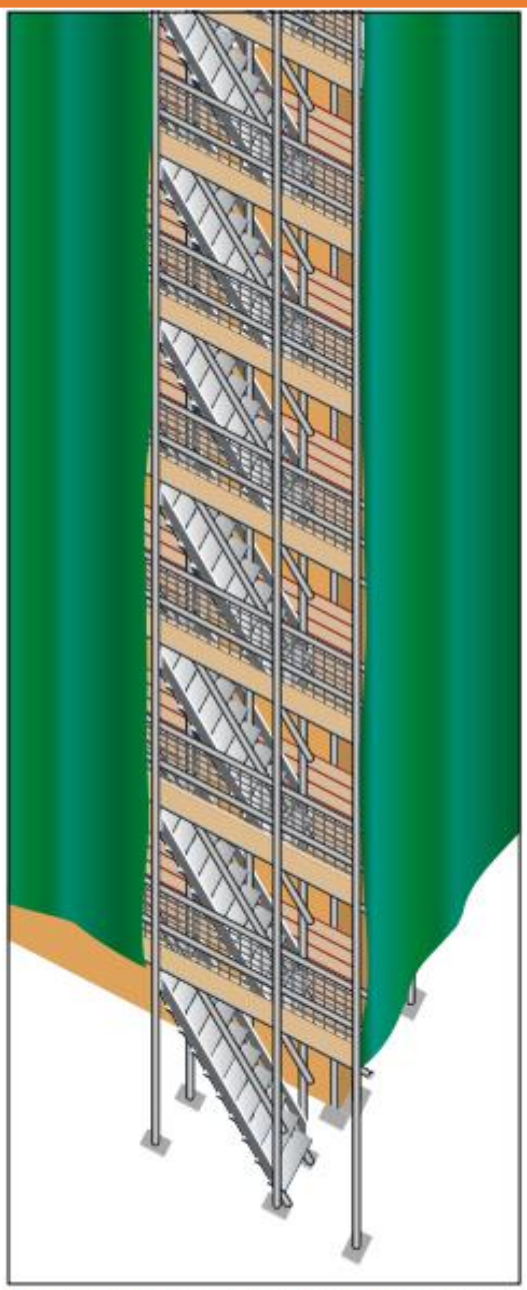


Figure 5 Where sheeted scaffolds form part of the escape

Figure 6 Most construction rubbish can burn. Make sure that it is swept up and removed from the site as soon as possible

Rubbish disposal

The Site Waste Management Plans Regulations 2008 (SWMP)R are enforced by the Environment Agency. SWMP sets out how building materials and resulting waste are to be managed during the project. When developing the waste management plans, the risk from fire should be assessed and any controls deemed necessary implemented.

All construction sites, especially in the latter stages such as fit-out, can generate large amounts of mostly combustible and easily ignitable rubbish. Implementing simple site rules can prevent the accumulation of rubbish (see Figure 6).

The following should be considered.

- Set site rules and ensure that they are followed, eg contractors must clear rubbish daily or more often.
- Provide facilities for storage of rubbish, eg skips.
- Keep flammable rubbish, such as contaminated rags, in a closed-top, fireresisting container, eg a metal dustbin.
- Situate rubbish skips outside (placing it so if it does catch fire it does not put at risk the site or other properties nearby).
- Store empty bulk fibre bags, sacks and wooden pallets in a safe place until they can be removed from site.

If a skip is less than 3 m away from other structures, precautions to prevent skip fires spreading to the structure include:

- situating the skip against a fire-resisting wall that is high enough to prevent fire from reaching other flammable parts of the structure, eg brick;
- avoid placing skips beneath canopies or overhanging eaves;
- using a chute made of non-combustible materials, such as those complying with BS 1703: 1977;
- restricting the amount of flammable material placed in the skip; and
- emptying the skip before it contains a significant fire load.

Demolition

Demolition work can involve a high risk of fire and explosion. In particular:

- dismantling of tank structures causing ignition of flammable residues; and/or
- disruption and ignition of buried gas services.

Buried and other service pipes should always be assumed to be present on a site unless it is positively confirmed that they are not. Identify the location of gas service pipes before any demolition work begins. The client or local supply company will often be able to provide indications of where pipes and cables are located, but this should always be accompanied by a survey of the site. A competent person should do the survey using service pipe-locating devices. Once the locations of all service pipes are identified, make arrangements to ensure that they are disconnected from the mains supply by a competent person and purged of any residual gas. It is extremely dangerous to merely assume that this has been done. It needs to be confirmed by a formal process in which a competent person, usually a representative of the local supply company, gives authoritative assurance of disconnection and clearance. Further information is contained in HSE publication HSG47 *Avoiding danger from underground services*.

Even if removal of the pipe services is not an intended part of the demolition job, it is still important to locate and isolate services to avoid damaging them. In some cases, it may be necessary for supply systems to remain charged. In such cases, particular care will be needed in implementing systems of work to minimize the risk of contact.

Storage tanks and drums often contain residues of flammable materials even tiny amounts of which can result in flammable and explosive concentrations. This is especially dangerous when hot work dismantling methods – including oxyacetylene cutting or methods generating ignition sources such as angle grinding – are used. Such methods should only be used after the tank has been thoroughly cleaned and certified gas and residue free by those who specialise in such work. This work is potentially extremely dangerous and specialised. Those doing it must be competent. (Consideration should be given to mass filling with concrete and leaving in situ.)

A full description of the extensive precautions needed in this work is beyond the scope of this guidance. Further information is contained in HSE guidance note CS15 *The cleaning and gas freeing of tanks containing flammable residues*.

Primary measures include:

- clearly identifying the contents of tanks and associated pipework;
- cleaning tanks and pipework before dismantling work begins;
- keeping to clearly defined systems of work during dismantling (PTW systems will be appropriate, see paragraphs 101–102 – Heading permit-to-work systems); and
- avoiding hot work wherever possible, for example, by the use of hydraulically powered shears.

General fire precautions

If there is a fire, people need to be able to evacuate the structure and possibly the construction site itself to reach a place of safety. **It cannot be over-emphasised that the main aim is to ensure everyone reaches safety if there is a fire.** The means of escape may need to be considered daily on fast-tracked projects.

Buildings are often at their most susceptible during the construction phase. Some timber frame structures are vulnerable to rapid fire spread and possible collapse in the early stages of construction as the timber is not protected. Other building types may be more at risk later on in the contract when there is an increased amount of flammable material such as packing or solvents. Many modern building types involve the on-site storage of large quantities of combustible materials (often insulation).

The term general fire precaution is used to describe the structural features and equipment needed to achieve this aim. GFP include such things as:

- escape routes and fire exits;
- fire-fighting equipment;
- raising the alarm;
- making emergency plans; and
- limiting the spread of fire (compartmentation).

The GFPs needed will vary from site to site. Sometimes they will be very simple and other times much more complicated, depending on the risks involved at each stage of the construction process. But, they all need to take account of the size of the site, the number of people present and the nature of the work being done. Individual elements of GFPs must be considered as part of the overall package and not in isolation.

The purpose of this section is to help decide which GFPs are appropriate in particular construction circumstances. An essential requirement is that GFPs and people's ability to escape should not depend on ad hoc arrangements, such as the use of manipulative devices, eg portable or throw-out ladders, or rely on rescue by others, such as the fire and rescue service.

Means of escape

Escape routes need to be available for everyone on the site. On open-air sites and unenclosed, single-storey structures, such routes may be both obvious and plentiful. However, in more complicated structures, especially where work is above or below ground, more detailed consideration will be needed:

- Proper provision is needed for all workers and visitors wherever they are and however transient the activity, eg workers on the roof or in a plant or lift gear room.
- During the course of construction, escape routes are likely to change and possibly become unavailable. It is important that replacement routes are identified and provided early.
- Building designs often incorporate fire escape routes for the eventual occupiers. For new buildings, these should be installed at the earliest stage possible to make them available for those undertaking the construction work. For buildings being refurbished, try to arrange the work to make use of existing escape routes and keep them available.
- In an emergency, escape via a scaffold is difficult. Try to minimise reliance on it. Where possible, provide well-separated, alternative access from a scaffold to escape routes in the main building floor.

Figure 7 Avoid creating dead-ends and misleading fire exit signage

- There should normally be at least two escape routes offering escape in different directions.
- Tower crane operators (or people in similar vulnerable or difficult areas) must be considered and the necessary controls implemented.

Escape routes need to be clear, uncomplicated passageways, properly maintained, prominently signed (see paragraph 214), and kept free of obstruction.

A basic principle of escape routes is that any person confronted by an outbreak of fire, or the effects of it, can turn away from it or pass it safely to reach a place of safety (see Figure 7).

Where this cannot be realistically accommodated, it is important to ensure that the risk of being trapped by a fire in dead-end situations is minimised. The risk can be reduced by ensuring that anybody in a dead-end does not have to pass through an area of higher fire hazard to reach a place of safety, and keeping the distance they have to travel in the dead-end as short as possible. For example:

- where operations of high fire risk are carried out, such as laying floor coverings or work on pipes which have carried flammable materials, nobody should have to negotiate their way past the work area or plant to make their escape; and/or
- combustible materials should not be stored or allowed to accumulate at the exits from dead-ends, such as by doorways from rooms or along narrow or restricted escape routes from dead-ends, such as corridors.

Table 1 Maximum travel distances

	Fire hazard		
	Lower	*Normal*	*Higher*
Enclosed structures:			
Alternative	60 m	45 m	25 m
Dead-end	18 m	18 m	12 m
Semi-open structures:			
Alternative	200 m	100 m	60 m
Dead-end	25 m	18 m	12 m

Notes
Semi-open structures are completed or partially constructed structures in which there are substantial openings in the roof or external walls, which would allow smoke and heat from any fire to readily disperse, and which are not at risk of exposure from radiation or direct impingement from a fire on the site.
Alternative escape routes should, where possible, proceed in substantially opposite directions. The principle is that they are sufficiently apart that any fire should not immediately affect both routes. As such, they should not be less than 45 º apart.
Dead-end travel distances are significantly restricted. This is so people have time to negotiate their way past any fire between them and the exit before it threatens their escape.
Lower-hazard areas are those where there is very little flammable or combustible material present and the likelihood of fire occurring is low. Examples could be steel or concrete clad framework or structures in pre-fitting-out stages.
Normal-hazard areas will cover the majority of situations. Flammable and combustible materials are present, but of such a type and disposition that any fire will initially be localised.
Higher-hazard areas are locations where significant quantities of flammable or combustible materials are present of such a type that, in the event of a fire, rapid spread will occur, possibly accompanied by evolution of copious amounts of smoke or fume. Normal precautions to minimise the fire load should ensure that such areas are rare on construction sites. Examples of where they might occur are demolition or refurbishment work involving oil-contaminated wooden floors or linings, and fixing floor and wall coverings using flammable adhesives

Travel distance

In a fire the effects of smoke and heat can spread quickly. It is important not to over-estimate how far people can travel before they are adversely affected by fire. Appropriate distances and the time taken to reach safety will depend on various factors, including how quickly the fire grows, the structure and layout of the building, the location of the fire and where people are relative to this.

Various fire safety guides give different travel distances for different classes of buildings, however, the following distances are for guidance only and may vary according to the risk assessment.

Table 1 gives maximum travel distances to a place of safety which experience has shown can be considered acceptable for a variety of situations. The distances given are from the fire to an exit from the structure, typically a door, leading to the outside at ground level, or to a stairway or compartment protected against fire.

The travel distances are measured as the actual distance a person must walk and not as the crow flies. Care should be taken to minimise obstructions so that maximum travel distances are not exceeded. It is sensible to arrange the work to keep travel distances as short as possible.

This guidance recommends that workplaces, wherever possible, have two separate means of escape in case of fire and, in the case of higher risk buildings, recommends a maximum distance of 25 m to safety, or to a protected route out of the premises.

It is important to remember that all recommendations such as travel distances are guidelines and must be considered as part of the overall package of fire protection measures. Variations from individual advisory standards have to be matched by a commensurate increase in other fire protection measures.

Some building trades associations issue their own specific guidance for particular construction methods and, in so doing, recommend travel distances slightly higher than those advised in the table above. However, these trade associations base these higher values on requirements that their members enhance other fire safety measures. One example is the UK Timber Frame Association guidance, which recommends a maximum travel distance of 35 m, provided that enhanced fire warning systems have been installed, and they include strategically placed automatic fire detection to give the earliest warning of fire to occupants. The earlier warning gives slightly more time for escape and to cover the additional travel distance.

Stairways

Careful consideration needs to be given to the means of escape from work areas above or below ground level. It is especially important to ensure that the stairways and ladders are located or protected so that any fire will not prevent people using them. Those planning the project should consider evacuation routes as part of the process and ensure that staircases are provided in preference to ladders where reasonably practical.

Except for small two-storey buildings with travel distances well within those given in Table 1 (refer to paragraphs 190–196) for dead-end travel, there is normally a need for at least one stairway to be protected against any fire in the main work area affecting it. In the finished building, this is typically provided by situating the stairway in its own dedicated, fire-resisting

shaft. In these circumstances, the travel distance is measured from the worksite to the door of the protected stairway.

Protected stairways will be a feature in many buildings. Therefore, it is a sensible precaution to install these and make them available as early as is practicable in the construction of new structures, before fire risks increase, such as when fitting-out starts.

Ceiling, wall or floor coverings which, if ignited, would allow the fire to spread rapidly, or the effects from it to be exacerbated, should not be used in escape stairways. The ideal surfaces are plaster or concrete, which may be painted or sealed, as appropriate. Protective coverings in escape stairways should be flame retardant.

Where possible, it is sensible to try and provide alternative protected stairways. For structures which are more than four storeys above ground, this is considered essential. With the exception of small basements, on subterranean structures, at least one stairway should exit to the open air at ground level.

Doors

Doors giving access to protected stairways should be fitted as early as possible. They need to be fire resistant and fitted with effective proprietary self-closing devices (see Figure 8a/b). Where necessary, gaps between doors and their frames should be suitably fitted with intumescent strip and smoke seals. The nominal minimum period of fire resistance considered appropriate for protected stairways is 30 minutes, which the doors and door set should be designed to meet.

Figure 8(a) Keep fire exits clearly signed and free from obstructions

Figure 8(b) This escape route will quickly fill with smoke in a fire because no fire door is fitted

The doors leading to the protected stairway and the final exit from it should open outwards in the direction that people will escape (if more than 60 persons are expected to use them). Revolving doors are not considered suitable as they can jam. For similar reasons, avoid sliding doors.

The doors must be easily and immediately openable from the escape side, other than by use of a key. If security is required, proprietary fastenings should be used, such as those which comply with BS EN 1125: 2008 or other relevant standards. Security doors and turnstiles should be configured in such a way that they do not prevent rapid egress from the site in case of an emergency.

If it is necessary to protect a stairway, corridor or other circulation spaces to ensure safe travel distances, the integrity of the enclosure is critical to its safe use in an emergency. Check that the doors are properly maintained and closed correctly. It is also important to check that there are no other openings present or made, eg for pipes, wiring and ductwork. If there are, infill them at the earliest opportunity. In refurbishment work, do not assume that there are no holes breaching the enclosure in the existing structure. Any gap that may cause a fire to spread from one side to another should be suitably fire stopped with fire-resisting materials. Fire can also spread rapidly over false ceilings.

External escape stairs and ladders

If the nature of the work means it is not reasonable to provide or maintain an internal protected stairway, external temporary escape stairs may be provided instead. Adequate stairways can be constructed from scaffolding (see Figure 9), or using a proprietary system. The important requirement is that the external wall against which the stairway is erected should be imperforate and afford a nominal period of 30 minutes' fire resistance for 9 m vertically below the stairway and 1.8 m either side and above, as measured from the stair treads. This means that all doors, apart from the uppermost one leading onto the external stairway, should have 30 minutes' fire resistance and be self-closing. Any other openings, including windows, which are not of fire-resisting construction, should be suitably protected, eg with plasterboard, proprietary mineral fibre-reinforced cement panels or steel sheets.

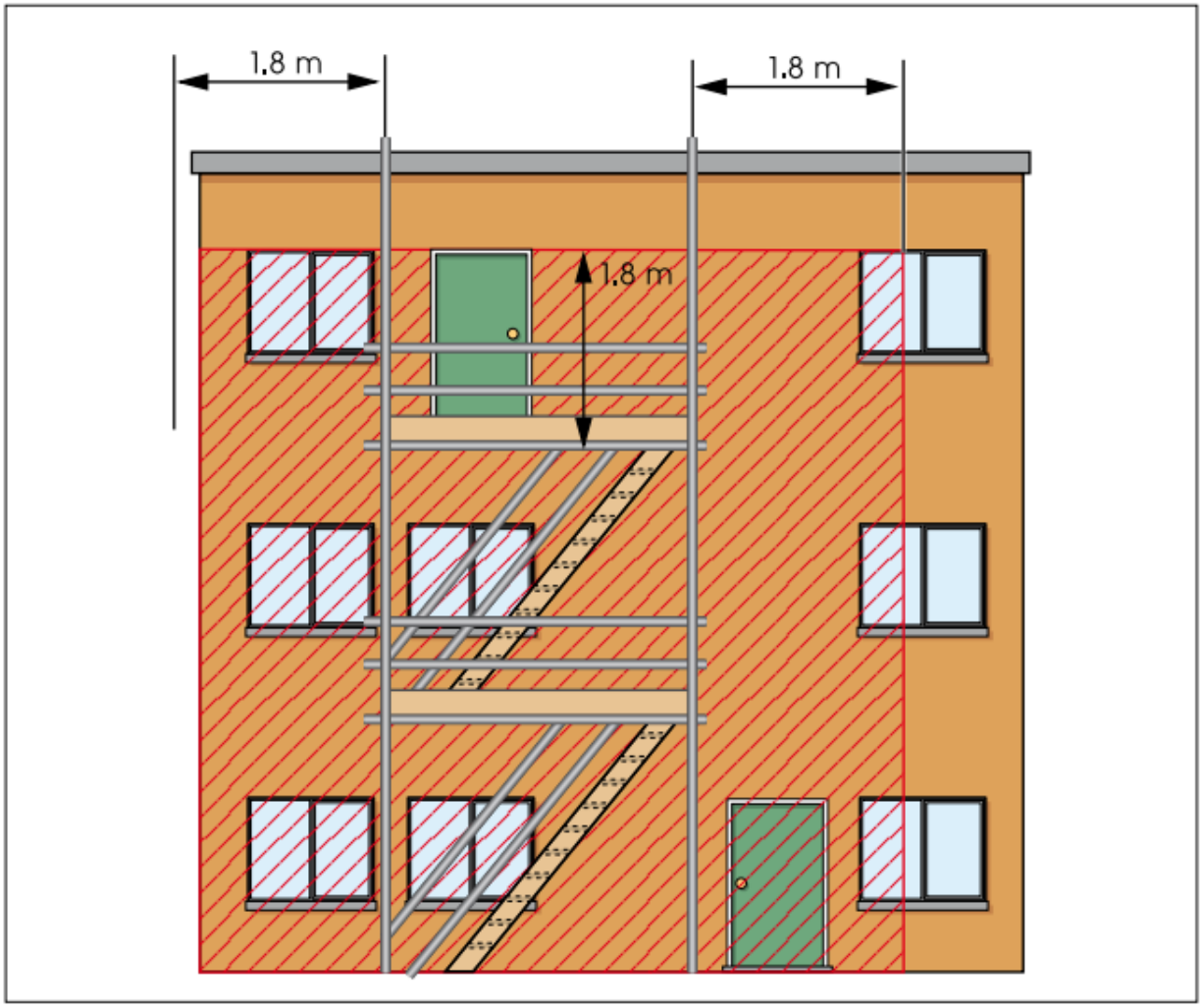


Figure 9 Temporary scaffold-based escape routes need to be protected from fire inside the building. The windows inside the shaded area need to be blocked off with fire-resisting material

In the open air, such as work on the initial framework of a structure, it is unlikely that an imperforate barrier will be available to separate the escape stairway from the work area. In such circumstances, unless the travel distances are well within those given in Table 1 (refer to paragraphs 190–196) for dead-end travel, at least two alternative routes should be provided. These should be well apart, ideally at opposite ends. If the structure or building is within a sheeted enclosure, eg for weather protection, environmental or safety reasons, at least one of the routes should be outside the enclosure (see Figure 10).

Escape route sizing

While stairways etc may be adequate for normal entry and exit, it is important not to overestimate their capacity in an emergency, when 'bottlenecks' can easily occur. Recommended widths are related to the number of people expected to use them in an emergency. For example, a stairway (in a building under construction) serving two floors should

normally be a minimum of 1 m wide to adequately cater for about 200 people. However, if the door leading to or from this is only 750 mm wide, the escape route via this door is only considered adequate for about 100 people. 209 More detailed advice on the size of escape routes can be found in BS 9999 and in Approved Document B and the Technical Standards that support the Building

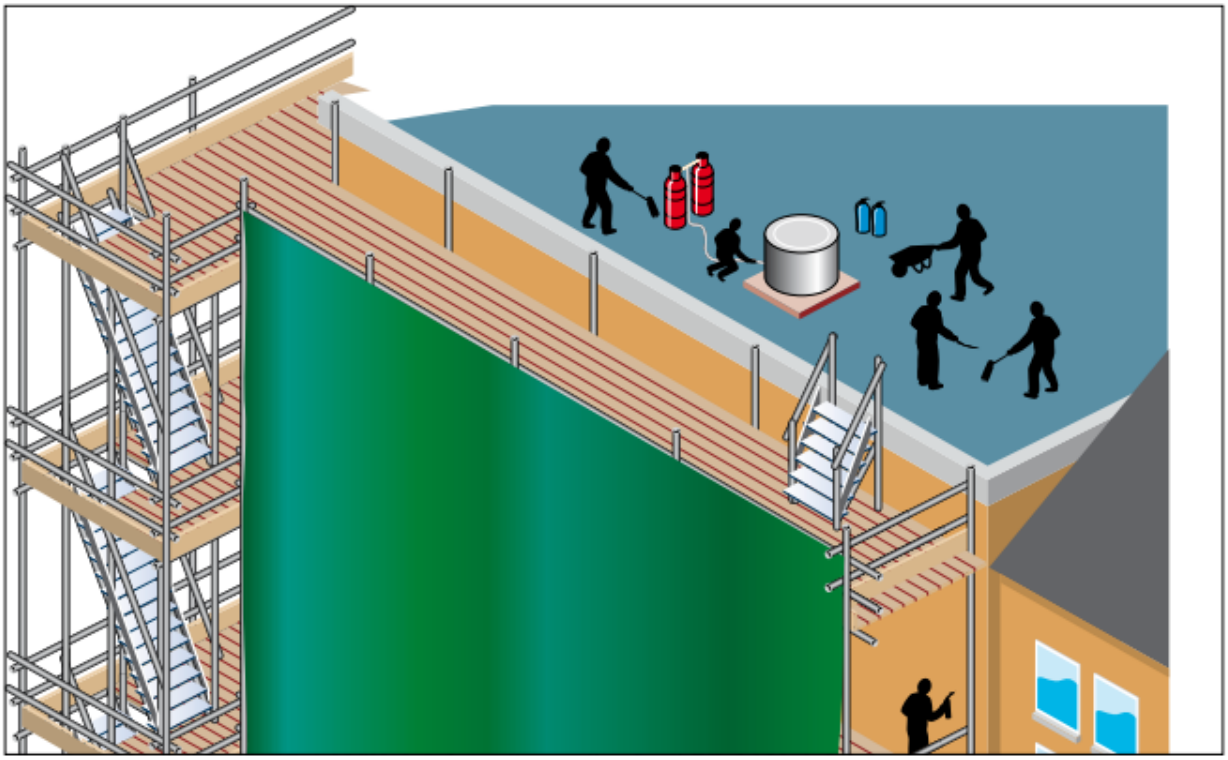


Figure 10 In this job, hot work on the roof and window renovation using blowlamps and substantial amounts of flammable substances mean the fire risk is high. Escape via ladders inside the sheeting could be difficult so external access is provided at one end. Some scaffold components have been omitted for clarity, eg roof edge protection is required. The escape route should lead away from the enclosure, where possible

Regulations and Building Standard (Scotland) Regulations respectively. The majority of structures will be built in compliance with one of these. Therefore, in most cases, the early installation of these escape routes will provide adequate means of escape during construction work. However, if during the construction work the number of people present is greater than the design maximum of the finished building, additional escape routes, or increased sizing of these, might well be necessary.

When temporary escape routes are required for changes in level (ie from one floor to another) you should consider the installation of proprietary all-metal system staircases. These can be adapted to any scaffold. If there are practical reasons why these cannot be used, such as a lack of space, under certain limited circumstances a ladder may be acceptable instead of stairs. Remember that fire precautions during the build should be considered at the design stage to ensure there is enough space for adequate precautions.

Remember, the speed at which people can escape via ladders is much slower. Ladders may be suitable for simple projects and for small numbers of able-bodied, trained staff. On complex or multi-storey projects proprietary stairwells should be used if reasonably practicable. It may be possible to sequence the building to commission early the permanent stairs to be used as an escape route.

Assembly points

All designated escape exits from the structure should give direct access to an unenclosed space in the open air at ground level. From here, there should be an unobstructed passageway from the structure to a place of safety where people can assemble and be accounted for. Regard needs to be given to the size and location of these assembly points:

Figure 11 Emergency signs

- on small sites – the pavement outside may be adequate; (provided this does not obstruct the fire service on their arrival);
- on larger sites – arrangements may have to be made to make use of an area such as a car park; and

- on sites such as chemical refineries – a safe refuge such as a plant control room may have to be used. Where the site is in operation, a responsible person from the company should be consulted regarding a safe assembly point.

Where the construction site is surrounded by a hoarding or fence and the assembly point is outside this, an adequate number of gates giving access to the assembly point will be needed. There should be clear and unobstructed access to the gates, which should be unlocked and available for use at all times that people are at work on the site.

Emergency signs

Escape routes need to be clearly indicated by proper signs (see Figure 11). The Health and Safety (Safety Signs and Signals) Regulations 1996 set the standards for these signs. They should comprise a white pictogram on a green background supplemented with text if appropriate. See HSE guidance L64 *Safety signs and signals: Guidance on regulations* for further details.

Signs need to be large enough so that they can be clearly seen and positioned where they are least likely to be obstructed or obscured by smoke. Typically, this is about 2 m above the floor, but the layout of the site may make alternative positioning more appropriate.

If emergency lighting is required (see Emergency lighting, paragraph 252), it may be convenient to use units which incorporate the appropriate fire safety sign. Photo-luminescent way-marking can also emphasise escape routes where lighting is poor.

Supplementary signs may also be required to clarify escape procedures, eg to inform how to open the door if this is not obvious, or where a patent security device is fitted, such as a 'Push bar to open' sign. Similarly, where there is danger that a fire exit may become obstructed, a conspicuous 'Keep clear – Fire escape' sign should be displayed. Signs complying with BS 5499: Part 1: 2002 are acceptable.

Signs need to be sufficiently durable to withstand site conditions, securely fastened and properly maintained (including kept clean).

If circumstances alter and any sign becomes inappropriate it should be removed. For example, if an escape route is changed it is imperative that signs giving misleading or confusing information are taken down and signs indicating the new route are displayed.

Training should be given to all workers (not forgetting workers that are not good at reading or for whom English is not their first language) so that they fully understand the signage in a fire emergency to ensure their safe escape.

Fire alarms

The aim of any fire warning system is to ensure that people on the site are alerted to make their escape before a fire becomes life-threatening. The essential requirements of the fire

warning signal are that it is distinctive, clearly audible above any other noise and is recognised by all the people on site.

False alarms and unwanted fire signals can be costly on any project and can also lead to complacency in those needing to respond. Careful selection of systems and management arrangements can reduce this nuisance.

The sophistication of the method of giving warning of fire will vary from site to site. For example:

- only on very small open-air sites, or those involving small buildings and structures, 'word of mouth' may be adequate;
- on a very limited number of open-air sites, or those involving buildings and structures with a very limited number of rooms, such that a shout of 'fire' might not be heard or could be misunderstood, a small self-contained proprietary fire alarm unit may well be needed;
- it is expected on the majority of sites that an inter-connecting (could be wired-in or wireless) system (see Figure 12) of call-points and sounders will be required to provide an effective fire warning system. For example, one that meets the requirements of BS 5839: 1: 2002 + A2: 2008; and
- consideration should be given to visual alarm systems (or other proprietary measures) for noisy areas or where there are workers who suffer from a hearing impairment.

Fire alarm systems will often be fitted as part of the construction work. Alternatively, buildings may have a wired-in fire alarm system already installed. Try and plan the work to install the fire alarm system as early as possible and, where a system is already installed, keep it in working order for as long as possible. Where they are relied on during the construction phase, it is vital that existing systems are not inadvertently disabled, for instance during work on electrical systems in refurbishment work. If they are disabled for any reason, alternative arrangements need to be provided.

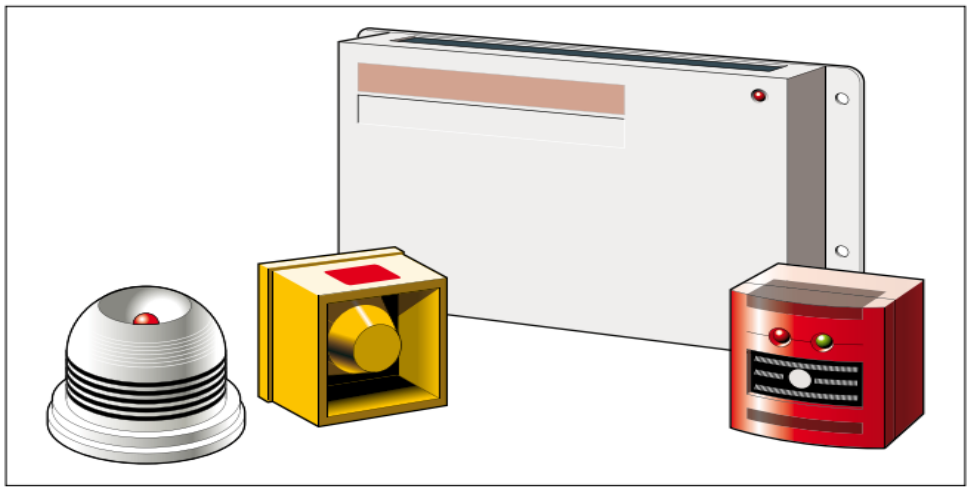


Figure 12 Alarms should be appropriate; on the majority of larger sites alarms should be interconnected (either wired or wireless)

225 There is not normally any need for automatic fire detectors to be fitted during construction work. However, on high-risk sites or in temporary accommodation units (TAUs) such as site offices, if there are locations where a fire might occur and develop unnoticed until it threatens people's means of escape, detectors may be appropriate. Domestic type smoke detectors are not considered appropriate on complex multi-storey sites, however, on small lower risk sites or small (TAUs) they may be acceptable.

Indicator panels sometimes form part of more sophisticated alarm systems. They can provide information on the location of the fire, though this may prove erroneous if a call point is activated elsewhere than in the vicinity of the fire. However, providing people are aware of the constraints of the system and understand what the signals mean, they can help inform what emergency actions have been taken, and be of use to the attending fire service.

When a fire is detected and the alarm raised, everyone should make their immediate escape without delay. If it is possible that a false alarm could cause significant problems, procedures to verify the outbreak of a fire should be developed. For example, on raising the alarm, perhaps by activation of a callpoint, an intercom system might be provided adjacent to this to allow verbal confirmation. This could be to a control centre from which the main alarm is then raised. Alternatively, the person in the control centre might be in radio contact with somebody on the fire floor. Safeguards need to be built into such procedures to ensure that, while anyone is on site, the control centre is **always** occupied (including during breaks) and, if the system for verbal communication fails, effective sounding of the alarm is not delayed.

The operation and effectiveness of the fire alarm system over the entire site should be:

- routinely checked (weekly) and tested by a nominated and competent person; and
- periodically serviced and any necessary rectification or repair carried out by a competent person having the appropriate level of training and experience.

The work should be carried out in accordance with the supplier's instructions or, where relevant, to an appropriate standard, for example, BS 5839: 1: 2002 + A2: 2008. Keep records of the work carried out.

It is especially important to ensure that, as the site develops, the alarm system is modified so that effective coverage of the entire site is maintained.

General means for communication should be tested daily, eg portable radios or any intercom devices should be checked at the start of shifts. Servicing should be in accordance with supplier recommendations.

Fire-fighting equipment

As well as providing fire extinguishers for specific activities, such as hot work or LPG storage, they should also be located at identified fire points around the site. Unless the equipment itself is predominantly red in colour and the location selfevident, identification of the fire point can

be achieved by providing a stand which is substantially red in colour, or providing an appropriate safety sign (ie one which complies with the Health and Safety (Safety Signs and Signals) Regulations 1996 or BS 5499: Part 1: 2002. Fire extinguishers should be located on hooks or stands to keep them above ground level.

The primary purpose of fire extinguishers is to tackle incipient fires to prevent them becoming larger, or to aid an escape. Putting out larger fires is the fire service's role and, as such, should not be tackled by site workers.

The extinguishers should be appropriate to the nature of the potential fire. For:

- wood, paper and cloth, use a water, foam or multi-purpose dry powder extinguisher;
- flammable liquids, use a dry powder or foam extinguisher; and
- electrical items, use a carbon dioxide (CO2) or dry powder extinguisher.

Extinguishers should conform to a recognised standard, such as BS EN 3–7: 2004. It is also important that there is an appropriate scheme to ensure they are regularly checked and properly maintained. This is not only to ensure that they are available and ready for use, but that accidents do not occur to the person using them.

Examine fire extinguishers and hose reels at least annually in accordance with a recognised procedure, such as that in BS 5306: Part 3, 2009 and BS 5306: Part 1, 2006 respectively. The work should be carried out by a competent person who has received appropriate training. The date and results of the examinations should be recorded, often on a service sticker attached to the individual piece of equipment, so that the particular extinguisher or hose reel checked is identifiable.

The number and type of extinguishers present depends on the fire hazard. For a typical spread of fire hazards, the following is considered to provide a reasonable level of cover per 200 m2 of floor area, with no fewer than two each of (a) and (b) on each floor:

- one 9 litre water or foam; and
- one CO_2 extinguisher (at least 1.1 kg).

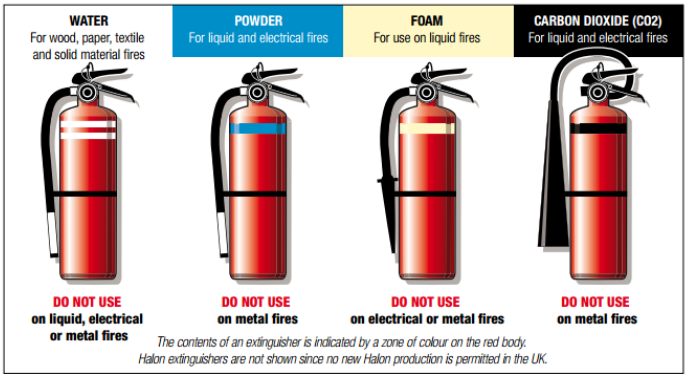


Figure 13 A selection of fire extinguishers. Fire extinguishers complying with BS EN 3 are red with a coloured zone identifying the extinguishing agent (eg blue for dry powder)

Note: Dry powder extinguishers may be provided in addition or substituted for any of these extinguishers, especially where the nature of the fire hazard warrants this. Dry powder does not have a cooling effect and may reduce visibility.

Hose reels may also be used instead of the water-based extinguishers. One per 800 m2 of floor area is recommended, but make sure it can reach all points of the area to be covered. Hose reels should be of an appropriate standard, such as BS 5306: Part 1, 2006 and, as with extinguishers, they need to be regularly checked, properly maintained and used by trained personnel.

It is important that everyone knows how to use the fire-fighting equipment. All fire-fighting equipment should have clear operating instructions with it. Those carrying out higher risk activities, such as hot work, need to be competent in the use of the fire-fighting equipment provided and training will normally be required to achieve this.

Larger and more complex structures, such as multi-storey buildings, may have fixed fire-fighting systems installed. These may range from dry and wet risers to automatic sprinkler systems. Dry and wet risers are provided for the fire service to tackle a fire quickly. The continued availability of these in existing buildings, and their early commissioning in new buildings, is therefore recommended. Similarly with sprinkler systems, it is worth planning the work so that these are available for as much of the construction phase as possible. Where risers are provided, liaison should be established with the fire service and the access points should be reviewed periodically.

Recognition should be given that sprinkler provision may have allowed for reduced fire resistance or extended travel distances. At construction stage this should considered and be incorporated into any fire evacuation planning.

If working on an existing building fitted with fire-engineered solutions such as sprinklers or smoke control and these are put offline, this needs to be reflected in the assessments and it may be necessary to liaise with the local fire service.

Compartmentation

To stop a fire spreading (in some types of high-risk structure this can be very rapid), a building can be sub-divided by fire-resisting walls, floors and sometimes ceilings. This is called compartmentation and a possible example of this was discussed in the protected stairway (see Stairways, paragraph 197). Compartmentation might also form a major part of the fire strategy for the completed building, especially for the larger and more complex structures. The early installation and completion of compartments can also provide protection during the construction phase. It should be given priority when planning GFPs but, in practice, there will be limits on how early compartmentation can be installed. Any openings need to be protected to an equivalent standard of fire resistance to the rest of the compartment. Work activities also

need to be carefully monitored to ensure that any holes or gaps remaining after services are installed are correctly filled in.

It is essential to maintain the integrity of compartments. Compromised compartments (eg with unprotected openings) do not work either during construction or in completed buildings and can undermine fire precautions catastrophically.

Horizontal compartmentation
To assist evacuation where compartments are large and exceed standards of fire resistance.
Vertical compartmentation
Compartments should provide a degree of protection above or below floor/ roof level.

To be effective, the compartment must be complete, without any voids and/or holes passing through it. The following are examples where compartments may be breached:

- refurbishment – consider concealed spaces such as behind panelling and cavity walls;
- raised floors for computer suites;
- holes requiring patching;
- voids/openings for services to pass through; and
- damage from site vehicles.

For escape routes, compartmentation can assist evacuation where areas are large and they should provide a degree of protection above or below floor/roof level.

Larger, more complex and prestigious buildings may entail fire-safety engineering solutions, making use, for example, of smoke control systems. The installation of the complete fire-safety engineered package of safeguards is recommended to be completed as soon as possible in the build. However, this cannot always be achieved and temporary compartmentation may be needed during the construction phase, eg of an atrium.

Temporary compartmentation (paying particular attention to stairwells, services duct, lift shafts and voids, providing a nominal period of 30 minutes' fire resistance, may be achieved by a timber studding framework faced with 12.5 mm thick plasterboard, skimmed with 5 mm of plaster to protect the joints (see Figure 14).

Alternatively, mineral fibre-reinforced cement boards can be used. Typically, boards need to be fixed to both sides of the studding. However, where it is concluded that the compartmentation is required to contain a fire on one side only, boards may only be needed on that side. Take the advice of the supplier on the methods of fixing and finishing needed to achieve the period of fire resistance in such circumstances. Where a fire compartment cannot easily be achieved automatic fire detection can be a compensatory factor.

Figure 14 Plasterboard partitions such as this can form effective compartmentation. It is important that all gaps are filled in. In this case, there are holes in the top of the partition and service ducts in the side rooms that need to be sealed

If there is a high risk of impact from vehicles, or other work activities that could breach the plasterboard compartmentation, it may need protection or other precautions to be provided.

Emergency lighting

Emergency escape lighting – to illuminate escape routes, fire-fighting equipment, escape signage etc.

Emergency lighting – to ensure tasks can be brought to rest/made safe when lighting fails.

Normal lighting could well fail during a fire. If work carries on inside enclosed structures or at night, emergency escape lighting will normally be required to ensure that escape routes can be identified and used safely (see Figure 15).

Escape lighting does not have to meet normal work standards but should be adequate for people to use the route safely.

For work at night on outdoor or substantially open sites, spill lighting from adjacent sites or locations (eg from street lighting) may be enough to enable escape.

Within buildings and enclosed structures, escape lighting (especially in escape routes) will generally be needed in the following circumstances:

- underground or windowless accommodation;
- stairs without natural, borrowed or spill lighting;
- internal corridors without borrowed light, which is of sufficient length that the escape route would be unclear; and/or
- where work continues outside daylight hours.

In the event of failure of the primary lighting, the emergency escape lighting needs to come on immediately. It may be powered, eg by a battery or emergency generator supply. The lighting should conform to a current BS or European Standard.

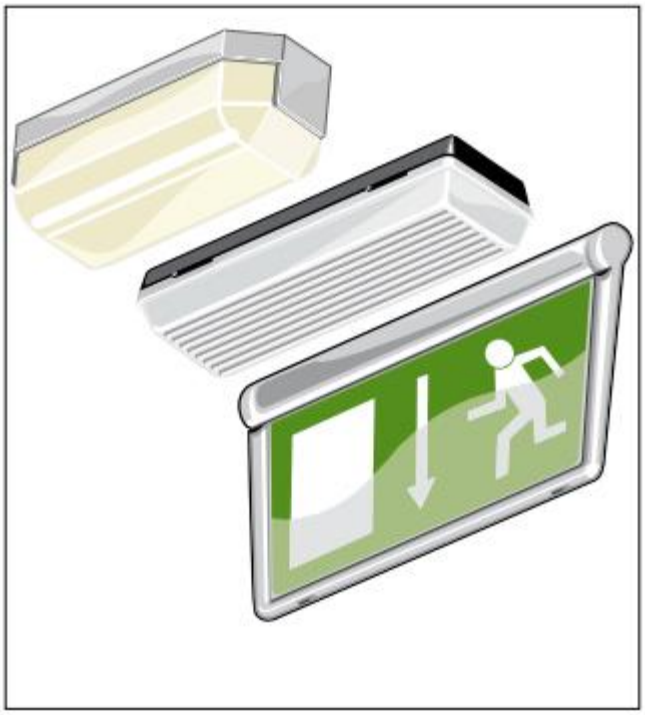


Figure 15 Typical emergency lighting units designed to operate in the event of mains failure. Emergency lights can usefully incorporate fire safety signs

If work is carried out in buildings in which such emergency lighting is already fitted, try to retain this for as long as possible. Similarly, if it is to be installed in a new building, try to arrange that the emergency lighting is done as early as possible.

The use of way-finding methods, such as photo-luminescent signs and paints, to indicate key escape route features can be useful. For example, to emphasise changes of floor level, stairs and ladders, and obstructions such as pipes or features which extend into the escape route.

The correct operation of the escape lighting systems should be:

- routinely checked and tested by a competent person;
- periodically serviced and any necessary rectification or repair carried out by a competent person having the appropriate level of training and experience; and

- the work should be carried out in accordance with the supplier's instructions or, where relevant, to the appropriate standard. Keep records of the work carried out.

Test escape lighting at a time of minimum risk, eg when the site is substantially unoccupied. Powered systems usually need to recharge, after tests.

Emergency procedures

The previous section described physical GFP measures. This section describes the management procedures to make sure that the physical measures will work effectively if they are ever needed. The key element is an effective emergency plan. This guidance concentrates on fire. However, there may be other potential problems for which emergency procedures and plans are necessary, such as flooding in excavations, tunnels, work near the sea or rivers, waterworks etc, or risk from asphyxiation or toxic gases. These may be integrated with fire procedures. Plan emergency procedures before the work begins and put general precautions in place to support these from the start of the work.

On existing occupied sites, liaise and agree emergency procedures with the other occupiers. Ensure that the means are in place to let each other know straight away if an emergency does arise. If simultaneous evacuation is needed, make sure the escape routes are of sufficient capacity to achieve this.

Some emergencies may require total evacuation of the site, eg where it comprises a single multi-storey structure. Some emergencies may only require partial evacuation, eg where a series of separate structures are present on the site. Some emergencies may require evacuation of adjacent premises. Careful thought needs to be given to ensuring that the means provided are appropriate and capable of achieving the desired goal.

As the nature of the workforce changes it is important that any procedures are understood. If there are personnel on site who do not speak English, it is imperative that any instructions or procedures are made clear and they understand what is needed in the event of an emergency.

Developing an action plan for fire

All emergency plans need to be clear, unambiguous and known to all who are on the site. When developing plans, consider the following aspects.

- Where will workers gather after evacuation from the site? Who will be in charge of the situation and what will be their role? What information and/or training will that person

need to carry out those functions? Fire wardens may need to be appointed to assist the person in charge.

- How will the people in charge communicate with each other? (Radios etc.)
- How will you check that everyone has reached the assembly point, eg head counts or checking off against site security logs brought to the assembly point? (Possible use of sweep techniques.)
- Who will contact the emergency services and how?
- Who will meet the emergency services when they arrive and provide them with information? They will need to know of any particular risks, such as the location of LPG cylinders and the likely whereabouts of anyone unaccounted for who may still be on site. Is the fire service aware and are up-to-date details available?
- Consider adjacent premises may need evacuation and how this might be done.
- The fire service should be informed of any items in the risk assessment (or changes through the building process) that could affect fire fighting or emergency operations, eg changes to access or water supplies.
- If the fire and rescue service is called to a fire when the site is unoccupied, or only occupied by security staff, how will the fire and rescue service obtain relevant information to enable them to work safely and effectively? Even if the site is unoccupied, they will still need to know of any particular risks, such as the location of LPG cylinders.
- Consider workers whose first language may not be English.

The number of people involved in managing the emergency response should be kept to a necessary minimum. This will reduce the scope for confusion between different parties carrying out different tasks during the emergency. Nominate and train deputies to cover for key personnel when they are absent, eg for sickness or holidays.

Fire wardens

On larger sites or higher fire risk sites, the appointment of fire wardens (or marshals) may be appropriate to:

- check that the site's fire precaution rules are observed, and that the GFPs remain adequate, available and in good order; and
- liaise with the fire service if there is a fire and provide information on access, people trapped and any special hazards etc.

It is important that when such people are appointed they are trained and given the necessary authority to carry out their tasks.

Liaison with the fire service

In some cases, it will be appropriate for those managing construction work to liaise with the local fire service before work starts. Where there is liaison, it is important that the fire service is kept informed of any changes affecting access and fire-fighting facilities as the work progresses.

Liaison with the fire service may be relevant, especially on large sites or if any of the following applies:

- There is a substantial risk to the public, eg where fire may result in the need for large-scale evacuation of heavily occupied neighboring areas.
- Large or high fire risk structures are built close to other occupied premises.
- There are particular risks posed to fire fighters, eg the presence of large numbers of gas cylinders or flammable liquids on site, timber frame structures, unusual construction techniques and basements or underground structures such as tunnels.
- There are highly flammable materials – consider HAZMAT warning signs for information of the fire service.
- The fire service's access to the site may be limited, ie if access roads are narrow and congested or there is no access available to one side of a large site.
- Water supplies are limited or do not exist, eg a large factory development in a green field site.
- Work takes place above 18 m (specialist access equipment may be required) and anywhere else where specialised rescue equipment may be needed, eg tunnels.
- Sleeping accommodation is provided for construction employees.
- Occupied buildings with large or high-risk occupancy are undergoing refurbishment.
- New buildings are undergoing partial occupation before completion (especially where the partial occupation is for residential use).
- The construction of timber-framed buildings creates a heightened risk of a fire spreading beyond the site to neighbouring buildings.

Liaison with the fire service provides them with important information which they can use to plan their response, especially for higher risk sites.

Monitoring GFPs and fire practices

272 It is important that escape routes are checked regularly by a competent person (this may be the fire warden/marshal). The frequency of this will depend on the complexity of the site and the rate of change. Usually a weekly check at least will be needed, and on larger and higher risk sites a daily check of the main escape routes.

Fire alarm systems should be checked weekly to ensure that they work and can be heard in real conditions. This should be at the same time each week and people should be informed that the alarm, at that time, is a test. Keep simple records.

Fire drills, in which the entire workforce evacuates the site, are a useful means of checking that the GFP routines are effective. However, it is recognised these can often be impracticable and of limited use due to the continually changing nature of sites and the workforce on them. But, as the risks of, and from, fire increase and the number of people on site rises, the need for a drill increases (often when the main structure of the building is complete) in order to check the training and understanding of all site staff and visitors, and also for problems such as 'bottlenecks' etc.

It is important to check that those on site really do know what to do if there is a fire. Asking individual workers: 'What is the fire alarm?' and 'What would you do?' are a useful way of checking that the instructions and information given have been adequate.

Fire instruction notices

Fire instruction notices (see Figure 16) should be displayed permanently and prominently on major escape routes, places where people meet, circulation spaces etc. They should also be up to date and take into account any important changes to the building and any escape routes, clearly outlining:

- the action to be taken on discovering a fire, including raising the alarm and firstaid fire fighting; and
- the action to be taken on hearing the fire alarm, including evacuation, assembly and accounting for people.

On larger and higher risk sites, consider supplementing these notices with information specifically given to the individual, eg as a card with the pay packet or information during site induction procedures. Site visitors also need to be made aware of what to do if there is a fire.

Fire instruction notices

The fire instruction notices are only intended to serve as a reminder. All people on site, even if they are there for just a few hours, should receive sufficient information to know what to do in the event of fire.

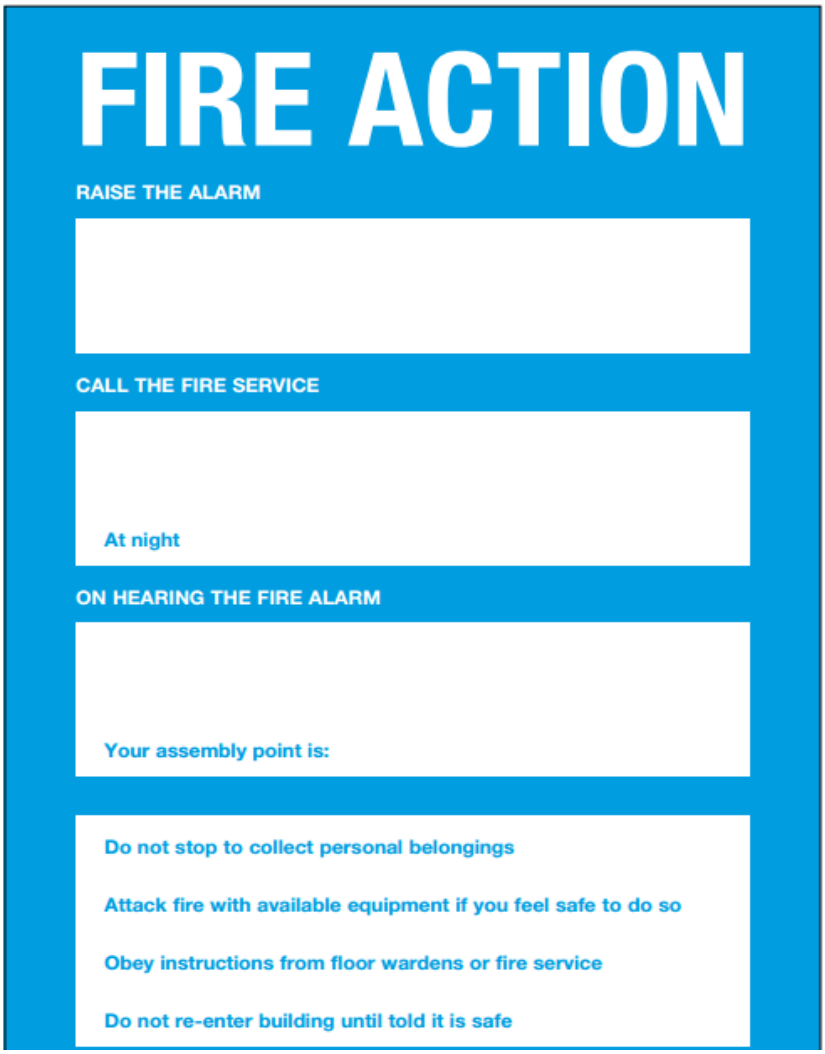
The minimum information that needs to be given, and should be given to people the first day they are on site, is:

- the location and use of the escape routes from their working area;
- the location and operation of the first warning system in their working area; and
- any significant fire hazard in their area of work.

People will need to be regularly updated on any changes.

People required to perform specific functions in the event of fire should be given the additional instruction and training needed for them to carry out their duties. For example:

- anyone expected to use fire-fighting equipment, including an extinguisher, should be given instruction and training on the correct selection and use of this. In particular, they need to know when to tackle a fire and when to leave it;
- equipment such as oxyacetylene equipment, bitumen boilers etc can turn small fires into very big ones if they are left on during a fire. Those in charge of such equipment should be instructed to turn them off, where this can be safely achieved without danger to themselves; and
- fire wardens, where they are expected to liaise with the fire service, require information to carry out this role effectively. They need to be kept up to date with changes to the site, including those that might affect access for the fire service, the location and number of people on site, processes presenting a high fire risk, and availability of water.



You must provide adequate fire safety training for your staff. The type of training should be based on the particular features of your premises and should:

- take account of the findings of the fire risk assessment;

- explain your emergency procedures;
- take account of the work activity and explain the duties and responsibilities of staff;
- take place during normal working hours and be repeated periodically, where appropriate;
- be easily understandable by your employees and other people who may be on site; and
- be tested by fire drills.

Your training should include the following:

- What to do on discovering a fire.
- How to raise the alarm and what happens then.
- What to do upon hearing the fire alarm.
- The procedures for alerting contractors and visitors including, where appropriate, directing them to exits.
- The arrangements for calling the fire and rescue service.
- The reporting of incidents and any near misses.

Higher fire risk methods and materials of construction

From conception, throughout the design phase and during the construction phase all CDM and FSO duty holders must consider the risks from fire. They should share information, co-operate and execute their legal duties under CDM to ensure all risks from fire are reduced to as low as reasonably practicable.

In most cases, taking the precautions outlined in this document will control the risk to an acceptable level. Certain build types are more vulnerable to fire during the construction phase and this section deals with the additional precautions which should be taken on sites which present a high risk from fire. In situations where fire spread from a construction site might endanger the lives of people in adjacent properties, and effective precautions to reduce this risk to an acceptable level cannot be identified or implemented, alternative build methods with a lower fire risk must be adopted.

Some methods of construction use technology, composite materials and conventional materials to produce buildings that are often cheaper and quicker to erect or have different properties to traditional buildings. Some of these components are produced off site and then assembled on site, doing away with or reducing the use of many traditional wet trades such as bricklaying, plastering and plumbing.
Because of the nature of their component parts, for example timber, they are more vulnerable to fire during the construction phase, when frames, supports etc are unprotected and exposed.

It follows that, during construction, fire preventative measures should be of the highest order, with a high level of housekeeping, to ensure that additional fire loading is kept to a minimum. Any fire at this time, when the supporting frame is exposed, may result in rapid fire spread, accompanied by structural collapse and the potential to spread to neighbouring properties.

From the start of the contract to hand over to the client, the person in control must be engaged in and aware of the control measures to be followed to prevent fires on site. Fire risk assessment should be carried out before the construction phase begins and arrangements for fire safety must be in place before work commences.

In these types of structures fire can spread extremely rapidly, making effective fire fighting almost impossible and extremely hazardous. In such cases, the complete loss of the building is almost inevitable.

Because of the potential higher risk, extra precautions may be needed at certain vulnerable times of the build. The precautions listed below, in respect of high-risk buildings, are additional to the other fire precautions discussed in this guidance for all projects.

See Appendix 3 for a checklist.

Timber frame buildings

Timber is an accepted form of construction and has been used as a building material for centuries. Building Regulations require a range of features in finished buildings to meet the high standards of fire protection applied to any other type of structure. The protection of a timber frame from fire is provided by the materials which cover the frame (eg plasterboards, plaster skim, tiles in non-combustible frames, appropriate insulating material etc). However, as with any other building, during the construction phase and before the protective measures in the completed building are installed high standards of control are needed to prevent/control fires and protect people.

During the planning phase, careful consideration will need to be given to both the on-site and off-site fire risks. In built-up areas, designers, clients and co-ordinators will need to evaluate the risk to surrounding premises. The risk will be greatest when the structure is erected but the protective measures are not yet installed. This period of maximum vulnerability, during which fire may spread quickly, must be considered in detail and minimised as part of the fire risk assessment. In situations where fire spread from a construction site might endanger the lives of people in adjacent properties, and effective precautions to reduce this risk to an acceptable level cannot be identified or implemented, alternative build methods with a lower fire risk must be adopted. Where sites are close to vulnerable property, such as residential or schools etc, the co-ordinator should discuss the risk with the fire service.

The principal contractor (main contractor on non-notifiable projects) will be in control of the site once the construction phase begins. The significant findings of the fire risk assessment, along with the action taken and the emergency procedures, should be incorporated in the construction phase plan prior to work commencing on site. The plan and precautions will need to remain under review as the project progresses. The principal contractor will need to liaise closely with subcontractors – particularly the timber frame supplier – to make sure the necessary fire precautions and emergency arrangements are in place and understood before they start work on site.

Dutyholders should give serious consideration to the use of timber and/or materials that have received an appropriate fire protection/retardant treatment for timber buildings. This will not only provide additional safety during the construction phase, but gives added protection for the completed building.

Large timber-framed structures should be subdivided into fire compartments at the earliest stage possible to prevent fire spread and ensure safe travel distances can be achieved for any personnel within the structure (see Table 1 – refer to paragraphs 190–196).

Where there are a number of timber-framed structures that are being built on one site, the risk of fire spread from one building to the next must be considered and controlled. For example, the installation of non-combustible materials such as the early completion of external façades can help to achieve this. This protection should not compromise any emergency exits.

The risk of the fire spreading to an adjacent property or properties outside the site perimeter should also be considered and, where necessary, controlled.

Composite building panels

Composite panels (sometimes called sandwich panels) consist of two metal faces positioned on either side of a core of a thermally insulating material. These are bonded together so that the three components act compositely when under load.

Many of the thermal insulating products used in sandwich panel systems are combustible (eg expanded polystyrene (EPS), extruded polystyrene (XPS), polyurethane (PUR), polyisocyanurate (PIR)). When openly exposed to a fire they will burn.

Designers should consider the potential fire risks when specifying composite panels in the structure. The risk may be better controlled by specifying a noncombustible panel.

As with other high-risk construction methods, incorrect installation, such as poor joint detailing and inadequate support, can lead to exposing combustible material directly to a fire condition.

Civil engineering projects

In some specific civil engineering projects, such as tunnelling operations, fire risks will need to be especially assessed. All dutyholders will need to consider fire risks from conception, design and construction phases. For example, it may not be practical to achieve the recommended safe travel distances. Specific, fireengineered measures may need to be implemented following assessment by a suitably qualified competent person.

Guidance for multi-storey buildings (new or refurbished)

There are many definitions for high-rise buildings. The Building Regulations, for example, require additional measures on buildings above 18 m. The important factor, in relation to construction site fire safety, is that the risks associated with the build can be adequately controlled, and the general fire precautions needed in the event of a fire are satisfactory to make possible the safety of any person on site. More complex and high-risk projects are beyond the scope of this guidance and you may need additional help with these from a competent specialist.

Process fire safety considerations for multi-storey buildings

The problems in multi-storey buildings under construction or refurbishment relate to the process of building. For example, many of the safety features that make the completed building safe in fire terms, such as correct compartmentation or fire-engineered solutions, are missing or incomplete.

Incomplete or absent fire-engineered solutions or incomplete compartmentation of the structure may lead to a very rapid spread of smoke and flames. Fireengineered elements of design may differ from what site staff perceive as the ‘norm’ and their performance in the overall fire strategy depends on their correct installation. If incomplete, their performance in a fire may not be as expected. In these circumstances, a specific fire risk assessment should be undertaken at the design stage (and included in pre-construction information) to develop appropriate provisions, primarily to ensure that the building can progress while protecting workers or others. It may be necessary to put in temporary compartmentation or other fire-engineering solutions.

Sites are often in built-up areas and within close proximity to other structures. The risks associated with this, such as access and risk to other properties, need to be considered from the design stage onwards.

It is becoming more common for completed floors of multi-storey buildings to become occupied by the client while construction continues on the other levels. Clients must very carefully consider the feasibility of partial occupation and address it at all stages, including the

design phase. If partial occupation is to be considered, the fire risk assessment must be completely re-evaluated.

It may be that the occupier does not allow those involved with the construction process access to occupied parts of the building, in particular stairwells and escape routes. If this is the case, it will be necessary to ensure that adequate means of escape can still be provided for construction personnel and that the fire alarm systems for the occupied parts of the building, and those still under construction, are co-ordinated. Remember, an emergency in the occupied parts of the building could affect the construction site and vice versa. It must also be noted that the fire enforcing authority for the GFP may change from HSE to the fire and rescue authorities (F&RA) in any partially occupied building.

The laws of physics dictate how high water can be pumped – so, as the building progresses, designers and principal contractors need to be aware and work with the fire service to address this, for example by early commissioning of rising fire mains and fire fighting shafts as the building is constructed and before work commences inside.

General fire precautions on multi-storey buildings

The provision of adequate GFP, such as escape routes, the travel distances to a safe place, lighting and means of raising the alarm, are also complicated in all areas of a multi-storey building as it progresses. There are a number of sites where construction progresses at heights at which normal fire protection measures may not be applicable.

Because of the extended times necessary to escape from the structure and to maintain the safe travel distances (see Table 1 – refer to paragraphs 190–196), compartmentation will be required. The compartmentation will need to prevent smoke and flames both vertically and horizontally. The following actions should be undertaken at the earliest opportunity:

- Compartmentation in buildings over 18 m should be created using temporary, fire-resisting materials having no less than one hour of fire resistance until the permanent fire-stopping arrangements can be put in place. Vertical risers, stair wells, lift shafts (including tower crane shafts) should be closed off at all levels, with self-closing doors having 30 minutes of fire resistance to separate them from the floors. Where reasonably practicable, all vertical shafts should be horizontally compartmented at intervals deemed appropriate in the fire risk assessment (not exceeding ten floors) to prevent the upward or downward spread of smoke and flames.
- The main stairways will probably provide the primary means of escape and, if this is the case, they will need to be provided with self-closing, fire-resisting doors (temporary if necessary) to protect their integrity. If the main stairways are not available then alternative protected routes will be needed. These alternative routes will have to take into account the number of personnel on the contract and safe travel distances.

- At least one staircase should be designated as the fire-fighting staircase for the use of the fire service during the course of an emergency.
- Any fire-fighting lift in the building should be commissioned and brought into service as early as possible.

As the building extends, it is essential that the fire alarm extends with it so that it is audible (and, where necessary, visible) in all areas of the build at all times. The fire alarm should be an electrically-operated system throughout the height of the building, comprising:

- manual activation points, eg break glass (or similar);
- call points and sounders on appropriate levels (it may be possible to install the hard-wired system as the building progresses but radio operated systems can also be considered);
- a link to an occupied office (or similar) from where the fire service can be summoned; and activated fire-fighting systems.

Other elements of the emergency plan must be put in place to accommodate the size of the build.

On large buildings, it is likely that temporary lighting will be provided for work to be carried out in the interior. Careful consideration will be needed on the provision of emergency lighting should the power fail for any reason.

If fire-engineering solutions, such as sprinkler systems, are to be installed in the completed building, consider commissioning them as soon as possible to ensure the safety of personnel during the build phase.

Due to fire protection often being incomplete during the construction process, the fire and rescue service may not be able to access parts of the building. Therefore, controls must be identified in the risk assessment to enable all site personnel to exit the building in an emergency without external assistance. These controls should be in place as soon as needed (whatever the height) because the site should not rely on the fire service to provide mechanical rescue.

When constructing or refurbishing high-rise buildings, it is therefore important to liaise with the fire and rescue service at regular intervals as the build progresses to be sure that fire fighters are familiar with the risks on the site and the controls that are in place.

Legal and enforcement responsibilities

Legislation

Several pieces of legislation govern fire safety for construction sites and construction activities.

The overarching health and safety requirements during construction work, which include fire safety, are provided by the Construction (Design and Management) Regulations 2007.

Other legislation covering fire safety includes:

- The Regulatory Reform (Fire Safety) Order 2005 (FSO) in England and Wales;
- The Fire (Scotland) Act 2005 (FSA) Scotland;
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR);
- Fire Safety (Employee's Capabilities) (England) Regulations 2010. (These Regulations apply in England only. They require that employers must take account of an employee's capabilities as regards fire safety in entrusting tasks to them.)

These make detailed requirements for fire safety, which also apply to construction work of a minor nature, eg decorating and maintenance work, and that incidental to the construction activity, eg provision of office and welfare facilities (including sleeping accommodation).

The legislation distinguishes between the general fire safety requirements for the premises and specific process-related fire safety requirements.

The general fire safety requirements are made under the FSO and the FSA; in the FSO they are termed 'general fire precautions' and in the FSA, 'fire safety measures'. These are defined in the FSO and the FSA as:

- measures to reduce the risk of fire on the premises and the risk of the spread of fire on the premises;
- measures in relation to the means of escape from premises;
- measures for securing, that at all material times, the means of escape can be safely and effectively used;
- measures in relation to the means of fighting fires on the premises;
- measures in relation to the means for detecting fire on the premises and giving warning in case of fire on the premises; and
- measures 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 FSO and FSA exclude specific process-related fire safety requirements. The term used conveniently to describe these is 'process fire precautions' (PFP) and is defined as those special, technical or organisational measures required to be taken or observed in any workplace in connection with the carrying on of any 'work process', where those precautions are:

- designed to prevent or reduce the likelihood of fire arising from such a work process or reduce its intensity; and
- required to be taken or observed to ensure compliance with any requirement of the relevant statutory provisions within the meaning given by section 53 (1) of Health and Safety at Work etc Act 1974.

'Work process' means all aspects of work involving, or in connection with:

- the use of plant or machinery; or
- the use or storage of any dangerous substance (as defined under DSEAR).

As such, in addition to DSEAR, PFP requirements can arise from other legislation made under the Health and Safety at Work etc Act, as well as HASWA itself.

Construction sites are also covered by the Fire and Rescue Services Act 2004 (in England and Wales) and the Fire (Scotland) Act 2005 in providing the Fire and Rescue Authorities responsibilities to respond to fire and other emergencies to protect life, the environment (including animals) and property. These responsibilities include:

- the right to access water supplies and enter premises where they reasonably believe a fire or other emergency has occurred;
- to take such action as they consider appropriate to prevent and limit injury and loss;
- to obtain information needed to enable the authority to discharge its functions; and
- to investigate the cause and extent of fires.

What does this mean for those with responsibilities for construction work?

The FSO and the FSA both impose obligations on persons (usually the employer, owner or occupier) as being responsible not only for the safety of employees, but for that of any person lawfully on the site, or in the immediate vicinity, and at risk from a fire on the site. They have the duty to implement and take adequate GFP/FSM for premises under their control.

Similarly, in respect of the legislation covering PFP, the duty is placed on the employer to implement and take appropriate precautions. In circumstances where there is not an employer, the responsible person in respect of the GFP/FSM legislation is the occupier, or in circumstances where they do not have control of the premises, the owner; and in respect of legislation covering PFP, the person undertaking the work.

Under CDM, there is a requirement for every contractor carrying out construction work and any person who controls the manner in which this is carried out, to ensure suitable and sufficient steps to ensure the risk of injury from fire or explosion that might arise from such work is prevented or reduced, so far as is reasonably practicable. Such steps to be taken include the provision of adequate GFP/FSM measures to enable persons on the construction site to safely and promptly escape from a fire or explosion and reach a place of safety.

The client and other dutyholders should provide pre-construction information allowing adequate provision of precautions to be developed. The contractor then has responsibility to ensure that adequate PFP and GFP/FSM provisions are made. In respect of construction work carried out on premises that remain occupied, or remain the responsibility of the owner/occupier, the contractor has a duty to liaise and co-ordinate the work with the owner/occupier to ensure adequate PFP and GFP/FSM provisions are made and the work is carried out in a manner that does not compromise these.

The owner/occupier of the premises also has a duty to provide the contractor with sufficient health and safety information for the contractor to identify the hazards and risks associated with design and construction work to enable them to put in place safe work procedures. This is especially pertinent where work is on plant or services containing dangerous substances, or such plant or services are close to the construction work and may be affected by this.

The FSO, FSA, DSEAR and other health and safety legislation covering PFP requirements requires a risk assessment to be carried out to determine the fire safety precautions provided are adequate to ensure, so far as is reasonably practicable, the safety of those on the construction site and any other persons who may be affected by a fire or explosion arising from the construction work.

An overarching fire safety risk assessment may be carried out covering the requirements of both the GFP/FSM and PFP legislation. This guidance (Part 1) is structured to assist in this approach and will help identify risks which can be removed or reduced and to decide the nature and extent of the fire precautions those with responsibilities for construction work need to take. Though, obviously, an individual is free to choose whichever method of risk assessment they find appropriate to their needs to satisfy the requirements of the legislation.

Where there are five or more employees on the construction site, the contractor should record the significant findings of the risk assessment. These findings should include the identification of any dangerous substances used, including its storage and/or plant or machinery presenting pertinent risk of fire or explosion that is or is liable to be present, and detail of the measures taken to comply with the requirements of the relevant GFP/FSM and PFP legislation.

For ‘notifiable projects’ under CDM, the principal contractor will have the particular responsibility to plan, manage and co-ordinate the construction phase to ensure the health and safety of those on the construction site, or who might be affected by it. As this includes the

risks from fire or explosion, there may be convenience in including the significant findings from the fire safety risk assessment in the construction phase plan.

The principal contractor is also likely to be responsible for office and welfare facilities (including sleeping accommodation, if provided). While this is outwith CDM, they might still find it convenient to include within the construction phase plan, especially if this is on the construction site and is likely to change during the course of the construction work.

Inclusion of the significant findings from the fire safety risk assessment in the health and safety file will also assist the CDM co-ordinator's demonstration to the client that the fire-related health and safety aspects of the design and construction phase work have been properly provided for.

For compliance with Building Regulations, licensing legislation and/or other contractual requirements, the completed building or structure will be provided with many of the fire safety provisions required for its eventual occupation and safe use. The designer should identify the risks that may arise to persons from fire and explosion during the construction phase (this should include the risks to those both on site, and those around adjacent buildings). In co-ordination with the client, CDM co-ordinator and principal contractor, the designer should determine the stages at which the fire safety provisions to be present in the final building/structure are implemented (or removed in the case of refurbishment/demolition), or compensated for until they are implemented, to eliminate or reduce these risks.

The client, designer, CDM co-ordinator and principal contractor should also consider how they will assist the fire and rescue authorities in the discharge of their duties under the Fire and Rescue Services Act 2004 (in England and Wales) and the Fire (Scotland) Act 2005. In any case, notice should be given to the F&RA of any intended works affecting the water supply and/or fire hydrants. But liaison is also appropriate to inform the F&RA of the nature of the work and the access facilities to be provided, including for fire appliances.

Under DSEAR, there is also requirement to make available to the F&RA information on the Dangerous Substances present on the premises and the hazards likely to arise from these in the event of incident, to enable the F&RA to prepare their own procedures to deal with these. On a construction site, it is likely the nature and quantity of any dangerous substances will change as the project progresses. Liaison should, therefore, take place with the F&RA to determine how the provision of information is best achieved.

Enforcement of fire safety legislation for construction sites, construction work and incidental activities

Because of the overlapping nature of construction-related and other fire safety legislation, inspectors from different agencies have different enforcement powers to deal with fire matters during the course of construction work. Primarily these are inspectors from:

- Health and Safety Executive;
- local authorities; or
- local fire & rescue authorities; and, in limited cases, inspectors from:
- Crown Premises Inspectors; or
- Defence Fire & Rescue Service.

The flow chart and diagrams indicate which inspector is the appropriate one for enforcement in which circumstance. Enquiries for the particular issue concerned are best directed towards the agency that has the enforcement power.

The primary purpose when an inspector visits a construction site and/or premises provided in support of the construction activity is to consider those health and safety matters for which they have formal enforcement powers. However, where they become aware of fire safety issues for which they do not have the appropriate enforcement powers they can refer these issues to the appropriate authority if enforcement action seems appropriate.