
ELEMENT 7 - FIRE SAFETY



Learning outcomes

On completion of this element, candidates should be able to demonstrate understanding of the content through the application of knowledge to familiar and unfamiliar situations. In particular they should be able to:

- Describe the principles of fire initiation, classification and spread and the additional fire risks caused by construction activities in an existing workplace
- Outline the principles of fire risk assessment
- Outline the principles of fire prevention and the prevention of fire spread in construction workplaces
- Identify the appropriate fire detection, fire alarm systems and fire-fighting equipment for construction activities
- Outline the requirements for an adequate and properly maintained means of escape in the construction workplace
- Outline the factors which should be considered when implementing a successful evacuation of a construction workplace in the event of a fire

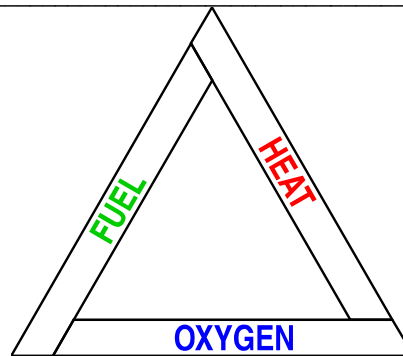
7.1 INTRODUCTION

Every year many construction workers are injured by fires, children and others may also be put at risk if construction activities are not managed correctly, in particular hot work such as welding may ignite other combustible materials which if not identified quickly may soon spread the fire to uncontrollable limits. (HSG168 Fire Safety in Construction Work)

There are around 4000 construction related fire annually. It is estimated that over 100 of these result in damages exceeding £50K and lead to major dislocation of project schedules.

Fire safety on site for new building and construction work is cover primarily by the **Construct Design and Management Regulations part 4** and the **Regulatory Reform (Fire Safety) Order 2005**. The CDM requirements cover new build sites during their construction. Where work is undertaken in an existing building the requirements of the Regulatory Reform order will also apply.

Fire is the chemical reaction called **COMBUSTION**, oxidation resulting in the release of heat.



Fuel	Combustible substance either solid, liquid or gas.
Oxygen	21% or more in the atmosphere and cylinders of compressed oxygen may be present
Heat	Required to reach the ignition temperature of the material as most substances are not combustible at ambient temperatures.

Once the reaction has started it generates it's own heat and while there is sufficient fuel and oxygen available it becomes self sustaining.

7.2 FLAMING COMBUSTION

Flaming combustion reactions occur in the vapour phase. Solids and liquids do not actually burn but decompose as part of the reaction in a process called pyrolysis.

The combustion reaction takes place just above the surface between the molecules of the vapour given off by the heated solid or liquid and the molecules of oxygen in the air. As this takes place above the surface it follows that an increase in surface area relative to volume makes combustion easier.

This is why substances such as wood shavings and the dusts or fibres of certain combustible building materials represent an increased fire hazard.

It also follows that flammable gases and vapours from petrol or solvents (which are obviously in the vapour state already) present a similar increased hazard. In addition they have the ability to spread and seek out potential sources of ignition at some distance from their origin.

The nature of the reaction also means that an oxygen rich atmosphere (e.g. from leaks in oxy-acetylene equipment) where there are more O₂ molecules present to interact with the combustible vapours will induce fire (or explosion) more quickly and it will burn with greater intensity.



7.3 MAIN CAUSES

- Smoking - discarded cigarettes
- Friction/Sparks from machinery such as abrasive wheels, disc cutters
- Electrical Systems & Appliances – overheating, use of inappropriate extension leads on site, over loading circuits in site accommodation, cables laid near combustible materials, intentional defeating of safety devices, mechanical damage to cables, make - shift joints,

- inappropriate use of electrical appliances
- Bonfires on site and the use of accelerants such as petrol to start them
 - Arson (by employees and intruders)
 - Static electric sparks
 - Lightning/Sun
 - Chemical reactions – Oxidisers i.e. bleach
 - Processes with naked flames e.g. welding
 - Prolonged exposure to sources of heat at relatively low temperatures

In addition to the above it is worth noting a number of other potential fire safety hazards typical to construction sites

- Widespread use storage and transportation of LPG and other cylinders of flammable gas or liquid and cylinders of oxygen
- Use of bitumen boilers
- Disturbance of buried gas services during ground work
- Removal during demolition of tanks used to store flammable materials
- Use and storage of solvents
- Refuelling of vehicles and plant on-site
- Build up of large quantities of combustible building materials at certain phases of construction
- Build up of large quantities of combustible waste materials
- Reduction of bulk building materials to dusts or fine particles which are more easily ignited

7.4 Hazards

- Smoke
- Gaseous Fumes From Combustion
- Oxygen depletion
- Heat / flames
- Structural Collapse, falling objects or people

7.5 CLASSES OF FIRE

A	SOLID FUELS - PAPER, WOOD TEXTILES
B	FLAMMABLE LIQUIDS
C	FLAMMABLE GASES
D	COMBUSTIBLE METALS
F	FLAMMABLE OILS
	ELECTRICAL FIRES
	VEHICLE FIRES

7.5. EXTINGUISHING THE FIRE?

CLASS	IDEAL EXTINGUISHER
A	WATER (Red) - Cools the fire
B	FOAM (cream band or label) or DRY POWDER (blue band or label) - smothers the fire
C	CO ₂ (black band/label), DRY POWDER – both smother the fire

However it should be noted that the principal method for extinguishing class C fires should always involve turning off the supply. Extinguishing gas fires will result in the leakage of unburned gas with a consequent risk of explosion. Water is often used to cool cylinders after turn off

- D SPECIALIST POWDER (Blue), GRAPHITE OR SAND
- chemical reaction which interferes with combustion / smothers the fire
- F FOAM BASED WITH SPECIAL ADDITIVES (yellow) – smothers/
cools the fire

ELECTRICAL CO₂ or DRY POWDER – smothers the fire

VEHICLE DRY POWDER – smothers the fire

OIL BASED /CHIP PAN FIRE BLANKET – smothers the fire

The British Standard and European Standard states that all extinguishers should now be red. Most new extinguishers will have a band or label of the colour previously used in the British Standard.

Q. What issues would you consider when locating fire extinguishers in the workplace?

- On fire routes near fire exits or in locations where they are really needed
- The appropriate extinguishers are positioned suitable to the fire risks in the area
- Accessible areas which all staff are aware of
- Clearly indicated with signage which adheres to Safety Signs Regs.
- Not obstructed / Not causing an obstruction to an escape route
- Fixed to wall or contained within a stand principally red in colour
- Visible
- As part of the equipment provided at the location where hot work is being undertaken

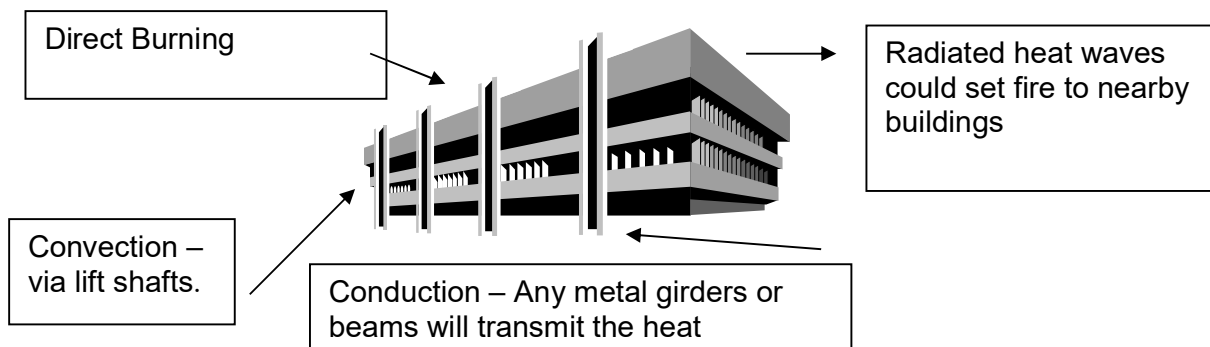
For a fire to be extinguished one side of the fire triangle must be removed

Cool – to remove the heat

Smoother – to remove the oxygen

Starve - by taking away the fuel, this cannot be achieved with a fire extinguisher.

7.6. METHODS OF FIRE OR HEAT SPREAD WITHIN A BUILDING



CONVECTION

Is the way heat travels via the natural movement of heated air currents. Within the confines of a building fire will spread upwards and through the building via the airflow. The hot air rises and also spreads out laterally if it meets any vertical barriers. If there are any open corridors or lift shafts, the fire, heat and hot brands will be spread widely and quickly by the convection currents. In addition the currents of hot air will carry smoke and toxic fumes produced by the fire so that people at some distance from the original location can be adversely affected very rapidly.

CONDUCTION

Is the passage of heat through a material. Some materials are better conductors (e.g. metals) than others (e.g. brick) so heat can travel through walls and ceilings to adjacent areas particularly through girders, metal partitions, pipes and joists.

RADIATION

Is the movement of heat energy via electro magnetic waves which travel through the air at the speed of light. The heat from the sun is a form of radiated heat. Radiant heat is readily transferred to buildings or other areas not shielded from the fire and as it passes easily through glass it can also spread fire to adjacent occupied buildings in close proximity.

DIRECT CONTACT

Is where the flames directly come into contact with a new fuel source. As a fire develops ever bulkier combustible items with a higher ignition temperature and "fire load" can become engaged increasing the intensity of the fire dramatically.



CAVITIES AND VOIDS

Are primarily by their very nature out of sight and as such can conceal a fire of considerable proportions before it becomes apparent.

They can form channels or passageways through which heat and smoke can move rapidly and unseen to other parts of a building often at considerable distance from the original fire. Fire fighting in such areas can prove problematic due to their inaccessibility.

Cavities and voids may be present in cavity walls between constructional walls and cladding between external walls and linings or as part of the internal divisions of the building between floors and ceilings and between structural and false ceilings.

Measure to reduce the risks associated with cavities and voids include:

- Ensuring separation between cavities and spaces is fire resisting.
- Providing fire resisting barriers e.g. above the structural or partition wall in the space between false and structural ceilings.

- Providing appropriate dampers in ducting which are activated by fire detection
- Ensuring the linings of such areas are non-combustible. Metal components which will afford heat transfer by conduction are enclosed in fire resistant cladding.
- Limiting size / cross communication and ensuring they do not compromise fire compartmentation.
- Ensuring that combustible materials are not stored in voids.

7.7. FIRE PRECAUTIONS

Fire precautions can be divided into two specific areas. Those which are intended to prevent fire occurring in the first place and others which are aimed at minimising loss of life and injury to people as well as loss of and damage to property should a fire start.

FIRE PREVENTION - Measures intended to stop a fire from occurring in the first place.

FIRE PROTECTION/MITIGATION - Measures which are intended to save life or minimise loss, by limiting the spread of fire and enabling people to escape safely should a fire occur.

CONSTRUCTION FIRE PREVENTION TECHNIQUES

- Reduce the amount of fuel available to a fire by limiting stocks of combustible building materials and the accumulation of rubbish close to sources of ignition or inside buildings
- Consider moving to the use of substances which are flame retardant / fire resistant
- Volatile flammable materials such as LPG cylinders are stored in a suitably secure external store. Access to be limited so as to control distribution/use around the site. Cylinders to be returned to the store after use/ at end of the working day
- Initiate a system where electrical equipment (and cabling) is checked on a regular basis particularly in relation to usage and the conditions in which it is being used
- Portable appliance testing is carried out on a regular basis
- Ensure that any electrical equipment or plant being employed in areas where solvents are being used or dusts are being generated is appropriately protected and will not overheat
- Initiate a Permit to Work systems for hot work (i.e. welding) Limit such work to trained competent staff only.
- Before hot work is started clear area of combustible items. Where this not possible erect suitable protection. Check the areas around and under where hot work has taken place up to an hour after the work has been completed
- Enforce a No Smoking policy or designate specific safe areas for smoking
- Ensure good security arrangements are in place, with no gaps in fencing and flammables appropriately locked away.
- Maintain plant and equipment in safe working condition
- If refuelling of vehicles or plant takes place on-site ensure a safe system is employed which takes place in the open air and away from potential sources of ignition
- Ensure portable lamps are appropriately secured so as not to fall over. Keep halogen lamps which generate large amounts of heat away from combustible materials
- Ensure temporary electrical installations are correctly installed. Any modifications or alterations to electrical systems are carried out by trained and competent staff
- Do not allow bonfires on site. Initiate a regular system for the disposal of waste so that

bonfires are only used in exceptional circumstances. If used they must be at least 10 metres away from buildings and other combustible materials. The use of accelerants such as petrol should not be employed and the bonfire must be attended at all times

- Regular inspections of the site to ensure fire prevention measures are in place and being adhered to
- Formal fire risks assessment updated as changes occur and work progresses

FIRE PROTECTION/MITIGATION MEASURES

- Means of escape: Provide suitable exit doors / points from buildings and the site. Provide adequate escape routes. Be aware there may be a need for additional temporary stairs to be formed from scaffolding and platforms in certain circumstances Update arrangements as construction progresses
- Develop a plan for the actions to be taken in the event of fire and ensure all staff understand it
- Where necessary appoint and train fire wardens to supervise and lead in a fire emergency
- Arrange specific fire assembly points where staff can be checked off
- Carry out fire drills to test the effectiveness of all of the above
- Provide a suitable fire alarm system to alert all staff
- Emergency lighting
- Make specific and suitable arrangements for calling the Fire Service and meeting and advising them on site
- Provide fire extinguishers and other fire fighting equipment appropriate to need particularly for hot work situations
- Utilise existing sprinkler systems in buildings being modified / renovated
- Provide or utilise existing fire resisting doors and fit with/maintain intumescent strips to prevent spread of smoke and gases
- Provide fire action notices exit signs and emergency lighting and be aware of the need to update and relocate as work progresses
- Install heat and smoke detectors or ensure those in existing buildings remain operational. Make requirements for reactivation of detectors following hot work part of the PTW
- Ensure regular maintenance and inspection of the means of escape
- Temporary accommodation units – should be kept clean and tidy, and have portable extinguishers installed. Smoking should not be permitted and suitable heating and cooking equipment and properly installed electrical installations are required. The units should be sited at least 6m away from the building if possible and need to have a means of escape and means of raising the alarm. As a general rule workers should not be permitted to sleep on a construction site. If worker caravans are provided experience has revealed that they can be highly flammable and can spear a fire very quickly if parked too close together. They should also be located at least 6 metres apart, and contain fire fighting equipment and means of sounding the alarm.
- Intumescent coatings reduce the spread of heat along metal girders. Strips of the same material can be found around the edges of some fire doors.



7.8 MEANS OF ESCAPE – This is the structural means forming part of the building whereby persons can escape from fire by their own unaided efforts to a place of safety. The overriding principle is that an individual should be able to turn his or her back on the fire and walk away to a place of safety.

It is obviously important that escape routes in the event of fire are available to all those on site no matter where they are working or how long they are going to be present on site. Where work is taking place on open sites or simple single storey buildings this may not be a problem but becomes a more complex issue where complicated multi storey structures are involved.

Considerations for means of escape

- As noted above the basic principle is an ability to turn away from a fire and move to a place of safety. With this in mind there should normally be at least two alternative escape routes leading in different directions.
- It is important to bear in mind that escape routes will change or perhaps become unavailable as work progresses so staff will need to be updated on alternative routes which need to be identified.
- The design for any new building is generally going to provide for means of escape so it makes sense to incorporate these at the earliest opportunity if possible. Similarly keeping pre-existing escape routes available and unobstructed when engaged in refurbishment work also makes sense.
- Escape routes should involve clear unobstructed and well maintained passageways. In light of these requirements it is best practice to minimise the use of scaffolding as the means of escape. Where it is possible arrangements should be made for two well separated routes from scaffolding leading to escape routes in the building.
- Where dead end situations prove unavoidable the risk should be minimised by ensuring that anyone trying to escape is not forced to negotiate a high risk fire area and the exit and route from the dead end is kept free of combustible materials. Work may need to be scheduled accordingly to ensure the former does not occur.

Travel distance

The effects of convection in a fire situation mean that heat and smoke can travel around a building very quickly. Experience has shown that it is best not to overestimate how far people are required to travel to reach a place of safety in a fire emergency. With this in mind appropriate maximum distances of travel to get to exits from buildings or to fire protected stairways or compartments have been calculated which are considered acceptable for a variety of circumstances:

	Fire Hazard		
	Low	Normal	High
Enclosed structures			
Alternative	60m	45m	25m
Dead end	18m	18m	12m
Semi open structures			
Alternative	200m	100m	60m
Dead end	25m	18m	12m

Distances – as the person is obliged to walk

Alternative - routes that lead in substantially different directions. The rule is that they are only considered to be alternative if they are at least 45 degrees apart from where the person is working.

Stairways and doors

Except for small two storey buildings where the travel distance is inside those given for dead end situations in an enclosed structure there is normally a need for at least one stairway to be protected against fire:

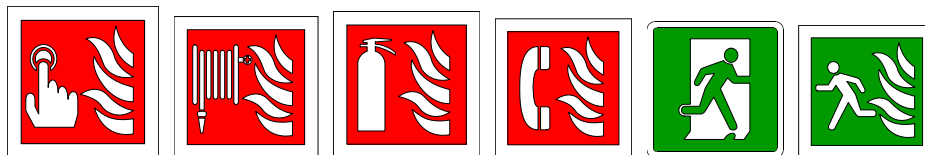
- Combustible materials should be used for ceiling wall or floor coverings in escape routes. Ideal surfaces are plaster or concrete
- Temporary protective coverings in escape stairways need to be flame retardant.
- Alternative protected stairways are considered essential for buildings more than four storeys.
- Any pipe work or wiring that breaches the enclosure to be in-filled / fire stopped.
- Doors accessing protected stairways need to have minimum 0.5 hour fire resistance and be fitted with a self closing device.
- Doors to be openable from the escape side and open in the direction of travel.

External escape stairs

Where it is not possible to provide an internal protected stairway it is permissible to provide temporary external escape stairs:

- Permissible to construct from scaffolding and use wooden treads and platforms
- Must be constructed against an imperforate external wall which provides 0.5 hour fire protection for 9m vertically below the stairway and 1.8m either side and above.
- Should be external to any sheeted enclosure.

7.9 FIRE SAFETY SIGNAGE



7.10 EVACUATION PROCEDURES

Any training given to employees should emphasise that they should only use a fire extinguisher to tackle a fire if they feel safe to do so, when they know the type of fire they

are tackling and have access to the correct type of fire extinguisher. Many people put themselves at risk by tackling large fires which will not be extinguished with a small portable extinguisher. Others use the wrong extinguisher which can make a small fire potentially life threatening. It should also be noted that fire extinguishers could be used to aid escape from a fire in an emergency but should not feature in any systematic approach to escape.

RAISE THE ALARM
TACKLE THE FIRE IF SAFE TO DO SO
EVACUATE and CLOSE DOORS IF POSSIBLE
CHECK ALL VISITORS AND EMPLOYEES ARE OUT OF THE BUILDINGS OR OFF
THE SITE
GO TO ASSEMBLY POINT

7.11 RECORD KEEPING

The following records must be available to a Fire Services Officer or HSE Inspector if requested:-

- risk assessment and evidence of remedial action
- fire extinguishers - types and location & maintenance records
- details of any fires (whether the fire brigade was contacted or not)
- inspections of workplace
- fire drills
- employee training records
- fire warden training records
- fire induction records
- maintenance records for electrical equipment/sprinklers/flooding systems
- emergency lighting testing
- plan of site
- evacuation procedures

7.12 FIRE RISK ASSESSMENT

The employer must carry out a fire risk assessment and decide what fire reduction measures are required. This follows very similar principles to those of a general risk assessment as required by the Management of Health & Safety At Work Regulations. This requirement has been reinforced by the Regulatory Reform (Fire Safety) Order 2005.

The responsibility has been removed from the Fire Authorities to issue a fire certificate as a means of ensuring the suitability of premises and replaced it with a broader responsibility on the employer or those in charge of premises to assess the potential for fire and the arrangements for dealing with it. It is a moot point whether those charged with this responsibility have the knowledge or experience to manage it.

Fire authorities will continue to offer advice to ensure employers who are able to discharge their new responsibilities. A series of new fire guides have been produced to take the employer through their responsibilities. These have key sections which are identical but then specific sections relating to areas such as factories, educational establishments, shops, offices and places of entertainment. They can be downloaded free of charge or purchased (www.firesafetyguides.communities.gov.uk or 0870 830 7099). These handouts supplement the guide provided with the more technical information in the syllabus.

Fire safety risk assessment

- 1 Identify fire hazards**
Identify:
 - sources of ignition;
 - sources of fuel; and
 - sources of oxygen.
- 2 Identify people at risk**
Identify:
 - people in and around the premises
 - people who are especially at risk
- 3 Evaluate, remove or reduce, and from risk**
 - Evaluate the risk of a fire starting
 - Evaluate the risk to people from
 - Remove or reduce fire hazards.
 - Remove or reduce the risks to people
 - Protect people by providing fire
- 4 Record, plan, inform, instruct**
 - Record any major findings and a

Hazard Identification: Consider the hazards which cause a fire to start, the features of the building the use to which it is put which may increase the risk of fire spreading and the storage of combustibles. The guidance points the way to consideration of the three elements of the triangle of fire in identifying sources of ignition, sources of fuel and sources of oxygen.

Who is at risk? Consider the number and nature of the people using the

building or site and in addition those in proximity to the premises who could be adversely affected.

Special attention to be given to those who may be especially at risk e.g. children / young people, those who would have difficulty evacuating without assistance, people working in isolated areas or near to fire dangers or people sleeping on the premises

Existing controls: Identify the current fire prevention and fire protection measures which are in place and working. i.e. fire extinguishes, non smoking policy etc.

Evaluation: Based on the hazards and existing controls evaluate the fire risk either of each department, the building, site or from each hazard.

Remove, reduce and Protect: Identify any additional control measures which need to be taken to prevent and protect.

Record, plan, inform, instruct and train: Record the significant findings from the risk assessment, prepare emergency plans, train and inform staff and others of these plans and co-operate with others on site.

Review: The whole assessment needs to be reviewed regularly and if there are any significant changes. Check that control measures are being followed by completing workplace inspections, checking maintenance records and observing staff in the workplace.

Note: See useful forms section for an extract fire risk assessment record form.

7.13 THE FIRE LEGISLATIVE FRAMEWORK - BACKGROUND TO THE NEW FIRE SAFETY ORDER

Prior to the introduction of the order UK fire safety provisions were scattered across more than 100 different pieces of legislation, all with a variety of implications on business premises, and some with overlaps between their requirements.

This proved very difficult and confusing for the business community as it attempted to remain compliant with an ever increasing raft of legislation. The aim of the Regulatory Reform (Fire Safety) Order 2005 – produced under the Regulatory Reform Act - is to 'simplify, rationalise and consolidate existing legislation' As noted above it also means that fire safety legislation now more closely mirrors that which applies to other health and safety matters.

MAIN REQUIREMENTS – As from October 2006

Where does the order apply?

The order applies to virtually all premises and covers nearly every type of building, structure and open space. For example, it applies to:

- offices and shops;
- premises that provide care, including care homes and hospitals;
- community halls, places of worship and other community premises;
- the shared areas of properties several households live in
- pubs, clubs and restaurants;
- schools and sports centres;
- tents and marquees;
- hotels and hostels; and
- factories and warehouses.

It does not apply to:

- private homes, including individual flats in a block or house
- certain business sectors where other specific legislation still applies e.g. mines, off shore installations.

What are the main requirements under the order?

Employers must :-

- carry out or appoint someone to carry out a fire-risk assessment identifying any possible dangers and risks;
- consider who may be at risk and those especially at risk; for the first time there is also a requirement to consider those at risk around the site as well as those in it
- eliminate or reduce the risk from fire as far as is reasonably possible and
- provide general fire precautions to deal with any residual risk that remains
- take other measures to make sure there is protection if flammable or explosive materials are used or stored;
- create a plan to deal with any emergency and, in most cases
- review plans and assessments when needed
- train and inform those on site
- provide minimum standards for warning and alarm
- ensure the means of escape is maintained
- appoint a responsible person to co-ordinate their fire safety arrangements
- maintain any fire protection systems

Employees must:-

- Take reasonable care of self and others
- Comply with any requirements imposed by the employer in relation to fire safety
- Inform the employer of serious and imminent danger
- Identify any shortcomings in fire arrangements (these are a combination of the requirements already in HASAWA and the Mgt Regs but here they are related to fire safety issues)

7.14 THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015 PART 4 FIRES AND EMERGENCIES

Prevention of risk from fire etc Regulation29

Precautions must be taken to prevent the risk of injury to any person arising from: Fire, flooding or any substance likely to cause asphyxiation.

Emergency routes Regulation31

- there must be a suitable number of emergency exits to allow persons safe exit in the event of emergency.
- these exits must be maintained clear at all times.
- emergency exits must be indicated with suitable signs which are illuminated if required.
- any exit must be suitable for the conditions, characteristics, size and numbers & location including plant and equipment & physical and chemical properties of any material.

Emergency procedures Regulation30

- arrangements must be made and implemented with regard to any foreseeable emergency.

Fire detection and fire-fighting Regulation32

- all persons required to use fire-fighting equipment must be instructed in it's effective use.
- instructed if at particular risk.
- the location of fire-fighting equipment must be indicated by suitable signs.

The HSE normally enforce fire safety on construction sites but if the site is shared with other people who are at work but not in construction it could be enforced by a Fire Services Officer and the local EHO.

7.15 HIGHLY FLAMMABLE LIQUIDS

Extra precautions are needed for highly flammable materials with a flash point of below 32°C, this includes many solvents, LPG, flammable gases and oxygen cylinders.

Flammable liquids are in common use in many industries, yet they have the power to destroy very easily if appropriate precautions are not taken. Substances with low flash points represent the highest risk. It is normally the flammable vapour which the liquid produces which is the fire hazard, mixed with air these can ignite very rapidly to give an explosion.

Almost all highly flammable (HF) vapours are denser than air, this means they will accumulate at the lowest point available possibly at some distance from the flammable liquid itself. The use of correct and suitable equipment for the storage, use and transfer of these liquids is essential if the risks are to be minimised.

Good ventilation in storage areas is essential, openings to provide ventilation should not ventilate into surrounding structures. Typically an opening of just 1% of the floor and wall area is sufficient but this may need to be up to 2.5% for flammable gases and oxygen.

Storage

Locate external stores in the open air at least 3 metres away from the building. The store should also be a similar distance away from the site boundary, drains or excavations.

External stores should be enclosed by a wire mesh fence at least 1.8 metres in height for security purposes with gates which are lockable. These stores should be used for flammable storage only and in particular LPG and acetylene cylinders should not be stored in the same area as oxygen cylinders.

Safety cabinets, ideally double walled for additional insulation should be provided. These can be fitted with air vents to enable spillage and leakages to be taken away safely. Safety cans can be used for storing smaller quantities of up to 20 litres. These have spring loaded self closing lids to minimise the vapour from them, some may have a flame arrestor in the neck to prevent the fire from occurring.

Small quantities up to 50 litres of highly flammables or 250 litres of flammables such as paints and adhesives should be stored in lockable steel chests or cabinets.

Never store LPG in unventilated metal boxes or huts, if there is a leak the gas may build up to a dangerous level.

The minimum amount of HF possible should be kept in the work area.

- HF should be stored in closed cabinets when not in use. These should be fire resistant.
- Cabinets or storage bins should be able to contain 110% of any spillage
- HF should only be kept in designated areas, ideally away from the process area.
- HF should be stored separately where possible and away from any incompatible substances such as oxidisers.
- The limits of 50 litres and 250 litres are only guidance but if amounts larger than this are stored in the workplace the risk of fire and an explosion increases and as such additional controls will need to be taken as a result of the risk assessment completed under the Dangerous Substances and Explosive Atmospheres Regs.

Rubbish Disposal – Arrangements should be for made for rubbish to be collected from site on a regular basis.

If skips are near to structures i.e. less than 3 metres away they should be located against fire resisting walls and consideration should be given to using non combustible chutes if they are required. It is important to restrict the amount of flammable materials placed in the skip and to arrange for it to be emptied before it contains a substantial fire load which could constitute a major hazard.

Even small quantities of waste contaminated with HF can cause problems if not stored correctly. Such waste should be placed in a waste bin with a self closing lid. It should be emptied regularly via arrangements with an approved contractor. It is best to avoid mixing wastes from different processes unless the substances are known to be compatible.

Protective coverings - are often using during construction over fixtures such as doors, handles and flooring, and can represent a substantial fire risk if there are ignition sources in the near vicinity.

Scaffold sheeting – in practical terms external scaffolding may make an additional contribution to escape in the event of fire. If they are to be relied on as a significant means of escape any scaffold sheeting used will need to be to flame retardant standards. If relied on as a major or sole means of escape the extent of sheeting needs to given careful consideration so as to reduce possible fire load minimise smoke logging and permit fire service access.

Site huts may be heated by LPG, if a leak occurs the vapour may build up and could asphyxiate or cause a fire or explosion. This is high risk if the hut is use during the night where people may fall asleep. All site huts and washrooms must be well ventilated at high and low levels. The pipe between appliances should be as short as possible, these should be disconnected or isolated when eh site closes.

Any pipe work used to transfer HF must be made form a suitable material compatible with the liquids being used. Plastic pipes may cause fire risks and have problem with electro static charges. Joints in piping should be kept to a minimum. Pipes must be located where they will not cause a problem if they do leak, i.e. above hot surfaces or naked flames.

Bottles with **self closing lids** should be used where possible

Sources of Ignition - These must be excluded from the areas where HF are being used, decanted and transferred. Electrical equipment in the nearby area will need to be intrinsically safe. Precautions to reduce the risk from static electricity will also be needed. Non conducting foot wear should be worn. Smoking must not be allowed near HF.

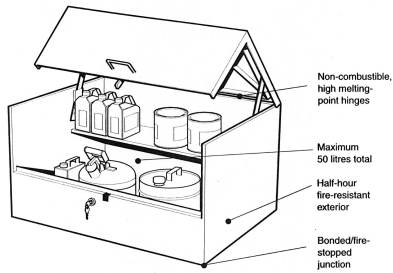
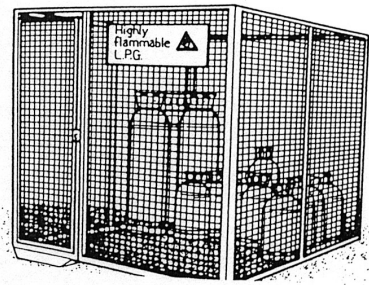
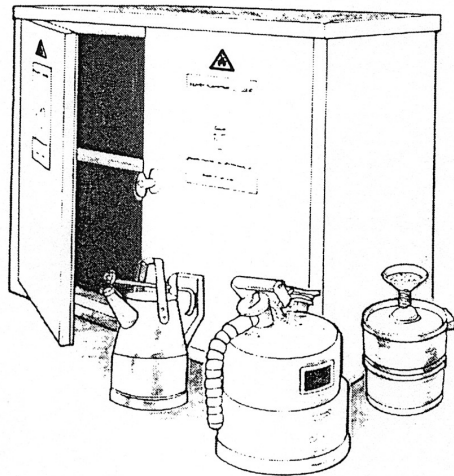
Training - All staff should know about the hazards of using HF's and the need to ensure ignition sources are controlled and eliminated in the work area. The training should cover as a minimum:-

- The types of HF in use
- Safe handling
- Use of PPE
- The importance of good housekeeping
- Fault reporting
- Spillage arrangements
- Emergency procedures
- Risk assessments (Dangerous Substances & Dangerous Environments Regs)

Drivers carrying more than two cylinders of LPG need to have received training and instruction on the hazards and risks and will need to carry a TREMCARD containing details of the load and emergency action

Practical Cylinder Storage & Handling Precautions

- store in an open space or properly constructed store room
- oxygen should not be stored in the same area as fuel cylinders
- store cylinders upright
- separate full from empty cylinders protect from sunlight and heat
- handle with care
- during transportation cylinders should be secured to prevent movement
- trained people (fire fighting and safe use and storage)
- never use/store on side
- suitable hoses and check prior to use
- do not drop or knock cylinders
- never repaint or change the markings on a cylinder
- do not use a cylinder which has been involved in an incident/fire
- never transfer the gas from one cylinder to another
- never roll a cylinder to its destination
- make sure cylinders do not get hot
- never oil or grease cylinder valves
- shut valves after use
- do not over tighten connectors
- check for leaks with soap water/detectors not naked flames

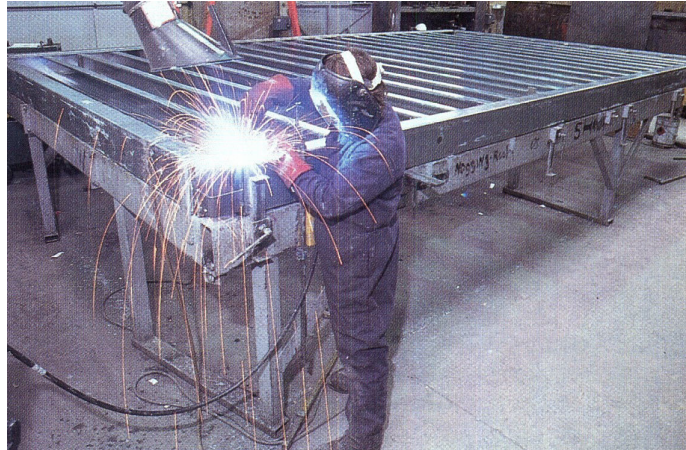


Storage in the workroom

7.16 WELDING

Welding, covers a number of processes in which two or more pieces of metal are joined together by the application of heat, pressure, or a combination of both.

The two processes most commonly employed are gas and electric arc welding.



a. Common Hazards

Most welding fumes is of a size range which can penetrate the inner parts of the lungs.

Inhalation is normally the main route of entry

Contact with Live Electricity – from electric arc welding

Fire - from arcs, flames & splatter

Explosion - vessels under pressure can explode

Toxic Fumes - Inhalation of welding fumes can cause welders lung (siderosis)

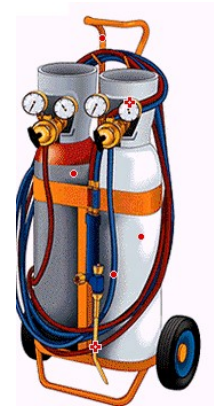
Heat - from the weld can cause burns

Radiation - ultra violet, infra red and visible light can be formed during welding.

Metal projectiles

Awkward working positions

Trailing cables/pipes – slips and trips



b. General Precautions

- Effective general ventilation must be provided, supplying 6 - 10 air changes an hour.
- Local Exhaust Ventilation will be required in designated welding areas
- Portable extraction equipment should be used for work carried out elsewhere
- Environmental monitoring may be required
- Welding in confined spaces will need to be controlled by a permit to work
- Good lighting
- Keeping combustible materials away from the welding activities
- Adjustable work benches
- Barriers/shielding
- Limit access to area
- Signage
- Permits to work
- Trained operators only



7.17 DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES (DSEAR) REGULATIONS 2002

a. Introduction.

DSEAR are concerned with protecting people against the risk from flash fires and explosions arising from dangerous substances and explosive atmospheres. Explosive atmospheres occur in commonplace activities such as wood machining, milling cereals, gas welding, spray painting, using LPG and flammable fluids.

More information can be obtained via : A "Short guide to the Dangerous Substances and Explosive Atmospheres Regulations" <http://www.hse.gov.uk/pubns/indg370.pdf>

b. Dangerous Substances & Dangerous Atmospheres

- A substance or preparation that because of its chemical and sometimes physical properties and the way it is present and/or used at work, creates a fire or explosion risk to people; for example substances like petrol, LPG, paints, cleaners, solvents and flammable gases;
- Any dusts which could form an explosive mixture in air (not included in a substance or preparation); for example many dusts from grinding, milling or sanding.

Commercial products with the following markings on containers.



OXIDISING



FLAMMABLE



EXPLOSIVE



GAS

Any substances or preparations which because of its physic-chemical or chemical properties creates a risk of fire or explosion.

c. Risk assessment

Before beginning work with a dangerous substance it is a requirement to **carry out a risk assessment**, to review it as necessary and to record the significant findings where 5 or more people are employed. Records must include the usual risk assessment issues (as required by Regulation 3 MHSWR 1999), and the precautions in place (or to be put in place) and specific information relating to the DSEAR requirements including information on zone classification and protected equipment. Employers should also consider:

- The hazardous properties of the substance,
- The safety information provided by the supplier,
- The circumstances of the work, the amounts used, the process and interaction or combined effects of more than one Dangerous Substance (DS), the arrangements for safe storage, transport and handling of the DS or waste containing a DS,
- Activities where there is a high level of risk such as maintenance,
- The effectiveness of measures that are taken,
- The likelihood of an explosion and its persistence or duration/effect,
- The likelihood that ignition sources or electrostatic discharges will be present,
- The scale of the anticipated effects of a fire or explosion,

- Other places which are or could become connected by openings to places in which explosive atmospheres can occur,
- Additional safety information needed by the employer to complete the risk assessment.

d. Elimination or Reduction of Risks from Dangerous Substances

There is a requirement to eliminate risk or, where this is not reasonably practicable, reduce risk by the application of a specified hierarchy of control :-

1. Avoid the release or minimise the release of dangerous substances,
2. Control the release of a DS at source,
3. Prevent the formation of a an explosive atmosphere which should include the application and use of appropriate ventilation,
4. Ensure that the release of a DS that gives rise to risk is suitably collected, safely contained, removed to a safe place or rendered safe by other appropriate means,
5. Avoid all ignition sources including electro-static discharges
6. Segregate incompatible dangerous substances.

e. Information instruction and training

- precautions and actions;
- details of the substances any relevant data sheets and legal provisions;
- the significant findings of the risk assessment.

f. Enforcement - The HSE or local authorities depending on the allocation of premises under the Health and Safety (Enforcing Authority) Regulations 1998. In the main, HSE will enforce at all industrial premises and local authorities elsewhere. The fire authorities will enforce general fire precautions at most premises subject to DSEAR.

7.18 PERMITS TO WORK.

As any hot work potentially generates sufficient heat to cause a fire consideration should be given to the adoption of a PTW system. The need for such a system will increase in relation to the amount of hot work being carried out on site and the risks involved e.g. the amount of combustible materials present.

As a formal management document a PTW should only be issued by those authorised to do so and must relate to specific defined pieces of work rather than representing a blanket authorisation to carry out hot work on site.

a. Contents of a PTW

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

b. Precautions to be noted in the PTW

- clear the area of loose combustible materials including areas on the other side of any wall or partition
- provision of an appropriate fire extinguisher during the work and after completion
- suitable protection of any combustible materials which are not removable from

the area

- inspection of the hot work area for a period of time after completion (usually 1 hour). With this in mind it makes sense to have a suitable cut-off time for the issue of permits related to the end of the working day
- isolation AND reconnection of any fire detections systems which may be present

In addition to the above it is important to ensure that any plant or electrical equipment used in a potentially flammable atmosphere is certified as being manufactured to the required BS for explosion protection.

Where equipment does not meet this standard it should be kept at a safe distance, at least 4 metres from the area.