# Element C1:

## General Workplace Issues

# Contents

# Safe Working Environment

Employers have a duty to provide and maintain a safe place of work and safe means of access and egress. The main requirements associated with this are provided below in a summary of the Workplace (Health, Safety and Welfare) Regulations 1992. A key requirement of a safe place of work is the design of surfaces to reduce slipping.

Slips and trips consistently account for around 1 in 3 nonfatal major injuries, and for over 1 in 5 over 3 day injuries in workplace areas throughout Great Britain, a total of at least 35 000 injuries per annum (one serious slip accident every 3 minutes). HSE statistics suggest that most of these accidents are slips, most of which occur when floor surfaces are contaminated (water, talc, grease, etc).

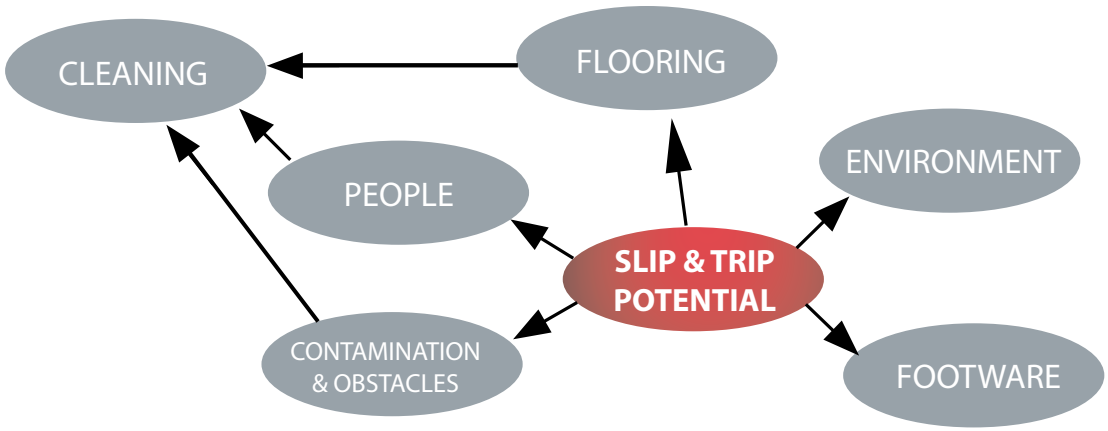
# The Design of surfaces to reduce slipping

Slipping accidents cause many thousands of occupational injuries every year involving broken bones, pain suffering and financial loss for society. The perception by the public, the workforce and by many who are responsible for designing floors for use both inside and outside is that these accidents are inevitable. The reality is that sensible precautions can and do eliminate the majority of these accidents and if the problem is explained and sensible floor choices made then the risks to those who ultimately use the floor can be managed more effectively. The right choice of flooring should be considered at the beginning of the design process taking a balanced view of cost, durability, aesthetics and safety, targeting those areas that get wet. Getting it right by design is a giant step forwards in reducing slip injuries!

# Slip and Trip Potential

The diagram below is the slip and trip potential model. The bubbles highlight the main factors that can play a part in contributing to a slip or trip accident. One or more may play a part in any situation or accident.

**Figure 1: Slip and Trip Potential**



# Flooring

The floor in a workplace should be suitable for the type of work activity that will take place on it. Where a floor can't be kept dry, people should be able to walk on the floor without fear of a slip despite any contamination that may be on it. So it should have sufficient roughness. [1] The floor should be cleaned correctly to ensure that it does not become slippery or keeps its slip resistance properties (if a non slip floor).

The floor should be fitted correctly to ensure that:

- there are no trip hazards; and
- to ensure that non slip coatings are correctly applied

The floor should be maintained in good order to ensure that there are no trip hazards e.g. holes, uneven surfaces, curled up carpet edges, etc.

Ramps, raised platforms and other changes of level should be avoided, if they can't they must be highlighted.

Stairs should have:

- high visibility, non slip, square nosings on the step edges;
- a suitable handrail;
- steps of equal height; and
- steps of equal width

# Environment

Environmental issues can increase the risk of, or prevent slips and trips, so it is important to take them into consideration. In this context 'Environment' means:

- Lighting (natural or otherwise);
- loud or unfamiliar noises;
- the weather;
- humidity; and
- condensation etc.

The environemnt can affect slips and trips in the following ways:

- too much light on a shiny floor can cause glare and stop people from seeing hazards on the floor and stairs;
- too little light will also prevent people from seeing hazards on the floor and stairs;
- unfamiliar and loud noises may be distracting;

- if rainwater gets onto a smooth surface inside or outside of a building, it may create a slip hazard. Good entrance design (e.g. canopies) can help;
- cold weather can cause frost and ice to form, which may create slippery surfaces. (Link to gritting); and
- condensation may make a smooth floor slippery.

# *Footwear*

Footwear plays an important part in preventing slips and trips.

Where footwear is not specified by an employer and therfore cannot be controlled e.g. pedestrians using a shopping centre thoroughfare. It is vitally important to ensure that smooth floors are kept clean and dry. For work situations where there is some control over footwear, but where floors are mainly clean and dry, a sensible footwear policy can help reduce risks. To prevent slips and trips sensible means: - flat, with a sensible heel, with the sole and heel made in a softer material that provides some grip.

In work situations where floors can't be kept dry or clean e.g. food preparation, the right footwear will be especially important, so a slip resistant shoe may be required. If an employer introduces a slip resistant shoe policy, the footwear will be considered to be personal protective equipment and will be subject to the requirements of the Personal Protective Equipment Regulations e.g. will have to be provided to employees free of charge.

Choosing the most suitable slip-resistant footwear for a particular environment / work activity can be difficult. Descriptions of slip-resistance given in suppliers brochures range from 'improving the grip performance' to 'excellent multi-directional slip-resistance', but often do not describe the work environments for which footwear are, or are not, suitable.

## Key points on soles and walking surfaces

The sole tread pattern and sole compound are both important for slip resistance. Generally a softer sole and close-packed tread pattern work well with fluid contaminants and indoor environments. A more open pattern works better outdoors or with solid contaminants. The only sure way to tell is to trial footwear in your environment.

Tread patterns should not become clogged with any waste or debris on the floor – soles should be cleaned regularly. If soles do clog up then look for an alternative design of sole, e.g. with a wider space between the cleats and a deeper tread pattern.

Slip resistance properties can change with wear; e.g. some soles can deteriorate with wear, especially when the cleats become worn down.

Have a system for checking and replacing footwear before it becomes worn and dangerous.

The correct choice of footwear on wet or contaminated profiled steel or aluminium surfaces, e.g. chequer plate, is important. With some footwear the surface profiles do not provide the improvement in slip resistance that might be expected.

'Oil-resistant' does not mean 'slip-resistant' – the former is just a statement that the soles will not be damaged by oil.

## Testing for slip resistance

Check with your supplier whether the footwear you are interested in has actually been tested for slip resistance – older models might not have been. Where footwear has been tested, coefficient of friction (CoF) test values must be available. CoF data can be requested from the supplier. Some suppliers now publish it in their catalogues. The higher the CoF, the better the slip resistance.

The Health and Safety Laboratory has developed a reliable and robust test method using these instruments to assess floor surface slipperiness in workplace and public areas. The method has been used as the basis of significant HSE and local authority action, from advice to improvement notices and prosecution.

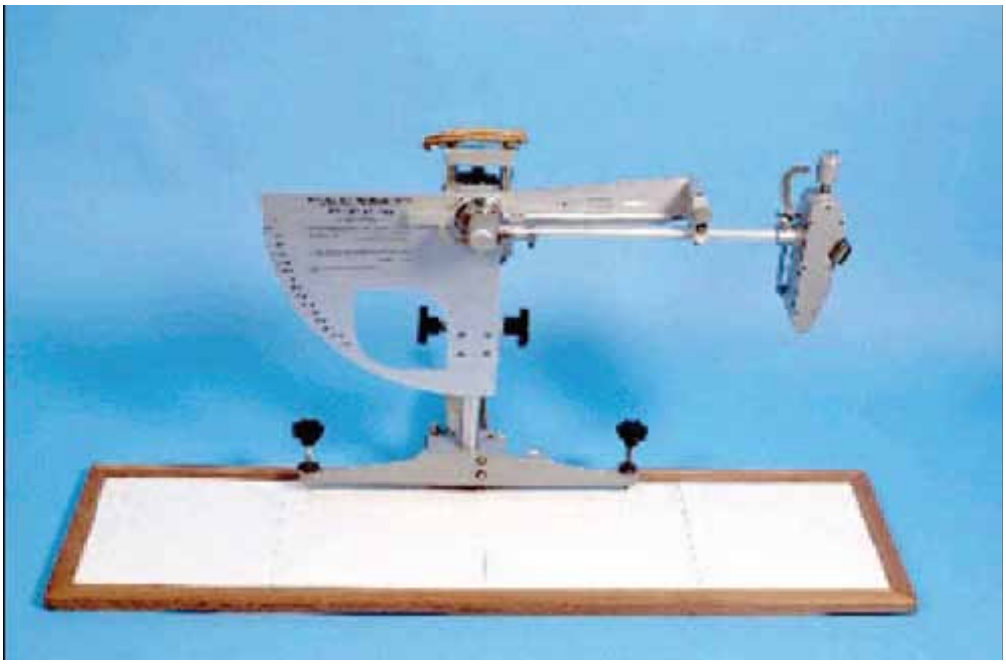
The methodology is based on using two instruments:

- a pendulum coefficient of friction (CoF) test (HSE's preferred method of slipperiness assessment, see Figure 2);
- a surface microroughness meter (see Figure 3).

**Pendulum**

The pendulum CoF test (also known as the portable skid resistance tester, the British pendulum, and the TRRL pendulum, see Figure 2) is the subject of a British Standard, BS 7976: Parts 13, 2002. 2

**Figure 2: The pendulum CoF test**



This instrument, although often used in its current form to assess the skid resistance of roads, was originally designed to simulate the action of a slipping foot. The method is based on a swinging, imitation heel (using a standardised rubber soling sample), which sweeps over a set area of flooring in a controlled manner. The slipperiness of the flooring has a direct and measurable effect on the pendulum test value (PTV) given (previously known as the Slip Resistance Value

Research has confirmed the pendulum to be a reliable and accurate test, leading to its adoption as the standard HSE test method for the assessment of floor slipperiness in dry and contaminated conditions. However, to use it reliably needs a suitably trained and competent person to operate it and to interpret the results.

**Interpretation of pendulum results**

Pendulum results should be interpreted using the information reproduced in Table # (from UKSRG, 2005).

**Table 1: Slip potential classification, based on pendulum test values PTV**

| PTV | |
|---|---|
| High slip potential | 0–24 |
| Moderate slip potential | 25–35 |
| Low slip potential | 36 + |

**Figure 3: Surface microroughness meter**


**Surface microroughness**

An indication of slipperiness in water contaminated conditions may be simply obtained by measuring the surface roughness of flooring materials. Roughness measurements may also be used to monitor changes in floor surface characteristics, such as wear. Research has shown that measurement of the Rz parameter allows slipperiness to be predicted for a range of common materials. Rz is a measure of total surface roughness, calculated as the mean of several peak-to-valley measurements.

**Interpretation of surface roughness**

When surface microroughness data is used to supplement pendulum test data, the roughness results should be interpreted using the information reproduced in Table 2 (from UKSRG, 2005). Where only roughness data is available, use it in conjunction with the Slips Assessment Tool (SAT) detailed below

**Table 2: Slip potential classification, based on Rz microroughness values (applicable for waterwet pedestrian areas)**

| Rz surface roughness | |
|---|---|
| Below 10 µm | High slip potential |
| 10–20 µm | Moderate slip potential |
| 20 + µm | Low slip potential |

## Contamination

In many cases floors only become slippery once they become contaminated. Preventing contamination can reduce or even eliminate the slip risk.

Contamination can be classed as anything that ends up on a floor e.g. rainwater, oil, grease, cardboard, product wrapping, dust etc. the list is endless. It can be a by-product of a work process or be due to adverse weather conditions.

Where prevention of contamination is not an option then alternative controls should be sought, e.g:

- drip trays for leaks;
- lids on cups and containers; or
- good sized mats at building entrances to dry feet.

Where contamination is expected on a floor then an effective cleaning response is required. Where the the floor is designed to cope with contamination and still be non-slip then the more viscous (the thicker) the contamination the rougher a floor will need to be in order for slips not to happen.

## Obstacles

According to the HSE 50% of all trip accidents are caused by poor housekeeping. Consequently good housekeeping should eliminate a large number of accidents, e.g. by:

- Ensuring there is a suitable walkway through the workplace;
- Keeping it clear, no trailing wires, no obstructions;
- Looking at people's workstations, are the floors tidy, do they have enough storage space?
- Considering other rooms? Are they tidy, are goods suitably stored, are there enough bins?

## Cleaning

Cleaning affects every workplace.

The process of cleaning can create slip and trip hazards, especially for those entering the area being cleaned, such as the cleaners, e.g. smooth floors left damp by a mop are likely to be extremely slippery and trailing wires from a vacuum or buffing machine can present a trip hazard.

An effective cleaning regime requires a good management system to identify problem areas, decide what to do, act on decisions made and check that the steps have been effective. Good communications are needed at all levels e.g. between equipment and chemical suppliers to ensure suitability of product for the likely type of contaminant and floor surface.

Effective training and supervision is required to ensure cleaning is undertaken to the correct standard. Cleaners should to be informed of their duties and why the cleaning needs to be undertaken in a particular way or at a particular time. Lack of understanding of the system of work may lead to inappropriate shortcuts being taken.

Contamination is implicated in many slip accidents. Regular and effective cleaning to remove contamination can reduce the risk of slipping accidents.

People can slip on floors that have been left wet after cleaning. Pedestrian access to smooth wet floors should be prevented by using barriers, locking doors, or cleaning in sections. Signs and cones only warn of a hazard, they do not prevent people from entering the area. If the spill is not visible they may be ignored.

There are many simple steps you can take to reduce risks, see examples below.

**Table 3: Slip/trip hazards and controls**

| Hazard | Suggested Action |
|---|---|
| Spillage of wet and dry substances | Clean spills up immediately, if a liquid is greasy, make sure a suitable cleaning agent is used. After cleaning the floor can be wet for some time; dry it where possible. Use appropriate barriers to tell people the floor is still wet and arrange alternative bypass routes. If cleaning is done once a day, it may be possible to do it last thing at night, so it is dry for the start of the next shift. |
| Trailing cables | Position equipment to avoid cables crossing pedestrian routes, use cable covers to securely fix to surfaces, restrict access to prevent contact. Consider use of cordless tools. Remember that contractors will also need to be managed. |
| Miscellaneous rubbish, eg plastic bags | Keep areas clear, remove rubbish and do not allow it to build up. |
| Rugs/mats | Ensure mats are securely fixed and do not have curling edges. |
| Poor lighting | Improve lighting levels and placement of light fittings to ensure more even lighting of all floor areas. |
| Slippery surfaces | Assess the cause and treat accordingly, for example always keep them dry if wet causes the problem. In certain situations you may have to treat them chemically and use appropriate cleaning method etc. |
| Change from wet to dry floor surface | Provide suitable footwear, warn of risks by using signs, locate doormats where these changes are likely. |
| Changes of level | Try to avoid. If you can't, improve lighting, add high visible tread nosings (ie white/reflective edge to step). |
| Slopes | Improve visibility, provide hand rails, use floor markings. |
| Smoke/steam obscuring view | Eliminate or control by redirecting it away from risk areas; improve ventilation and warn of it. |
| Unsuitable footwear | Ensure workers choose suitable footwear, particularly with the correct type of sole. If the type of work requires special protective footwear, the employer is required by law to provide it free of charge. |

## People or human factors

How people act and behave in their work environments can affect the potential for slips and trips.

A positive attitude toward health and safety, a ‘See it, sort it!’ mentality can reduce the risk of slip and trip accidents e.g. dealing with a spillage, instead of waiting for someone else to deal with it.

What footwear is worn can also make a difference e.g. wearing smooth soled shoes or high heels at work will make slipping anf tripping more likely.

Things that prevent people from seeing or thinking about where they are going, can also increase the risk of an accident e.g. rushing about, carrying large objects, becoming distracted whilst walking e.g. using a mobile phone

Physical attributes - If individuals have a physical problem that stop them from seeing, hearing, or walking in a regular manner it can increase the likelihood of an accident e.g. Vision, balance, age, disability that effects gait and ability to walk

# The Workplace (Health, Safety and Welfare) Regulations 1992 (as Amended)

## Requirements Under These Regulations – Regulation 4

Employers have a duty to ensure that every workplace, modification, extension or conversion which is under his control and where any of his employees work complies with the requirements of these Regulations. People other than employers also have duties if they have control, to any extent, of a workplace, e.g. owners and landlords (of business premises) should ensure that common parts, common facilities, common services and means of access within their control, comply. Tenant employers are responsible for ensuring that the workplace which they control complies, and that the facilities required by the Regulations are provided.

Where a workplace is in a building, the building should have a stability and solidity appropriate to the nature of the use of the workplace.

## Maintenance – Regulation 5

The workplace, and the equipment and devices mentioned in these Regulations, should be maintained in an efficient state, in efficient working order and in good repair. 'Efficient' in this context means efficient from the view of health, safety and welfare (not productivity or economy).

The frequency of regular maintenance, and precisely what it involves, will depend on the equipment or device concerned. The likelihood of defects developing, and the foreseeable consequences, are highly relevant. The age and condition of equipment, how it is used and how often it is used should also be taken into account. Sources of advice include published HSE guidance, British and EU standards and other authoritative guidance, manufacturers' information and instructions, and trade literature.

## Ventilation – Regulation 6

Effective and suitable provision should be made to ensure that every enclosed workplace is ventilated by a sufficient quantity of fresh or purified air.

Enclosed workplaces should be sufficiently well ventilated so that stale air, and air which is hot or humid because of the processes or equipment in the workplace, is replaced at a reasonable rate.

In many cases, windows or other openings will provide sufficient ventilation in some or all parts of the workplace. Where necessary, mechanical ventilation systems should be provided for parts or all of the workplace, as appropriate. Regulation 6 covers general workplace ventilation, not local exhaust ventilation. In the case of mechanical ventilation systems which recirculate air, including air-conditioning systems, recirculated air should be adequately filtered to remove impurities. Ventilation systems should be subject to a suitable system of maintenance.

Where necessary for reasons of health and safety, mechanical ventilation systems should

include an effective device to give visible or audible warning of any failure. This will not apply in most workplaces. It will, however, apply to 'dilution ventilation' systems used to reduce concentrations of dust or fumes in the atmosphere and to any other situation where a breakdown in the ventilation system would be likely to result in harm to workers.

Workers should not be subject to uncomfortable draughts. In the case of mechanical ventilation systems it may be necessary to control the direction or velocity of air flow.

Workstations should be re-sited or screened if necessary.

# Temperature in Indoor Workplaces – Regulation 7

The temperature in workrooms should provide reasonable comfort without the need for special clothing. Where such a temperature is impractical because of hot or cold processes, all reasonable steps should be taken to achieve a temperature that is as close as possible to comfortable. Excessive effects of sunlight on temperature should also be avoided.

# Lighting – Regulation 8

Lighting should be sufficient to enable people to work, use facilities and move from place to place safely and without experiencing eye-strain. Stairs should be well lit in such a way that shadows are not cast over the main part of the treads. Where necessary, local lighting should be provided at individual workstations, and at places of particular risk such as pedestrian crossing points on vehicular traffic routes.

# Cleanliness and Waste Materials – Regulation 9

The standard of cleanliness required will depend on the use to which the workplace is put. Floors and indoor traffic routes should be cleaned at least once a week. In factories and other workplaces of a type where dirt and refuse accumulates, any dirt and refuse which is not in suitable receptacles should be removed at least daily. These tasks should be carried out more frequently where necessary to maintain a reasonable standard of cleanliness or to keep workplaces free of pests and decaying matter. Interior walls, ceilings and work surfaces should be cleaned at suitable intervals.

Except in parts which are normally visited only for short periods, or where any soiling is likely to be light, ceilings and interior walls should be painted, tiled or otherwise treated so that they can be kept clean. and the surface treatment should be renewed when it can no longer be cleaned properly. This requirement of the ACoP does not apply to parts of workplaces that cannot be safely reached using a 5 metre ladder.

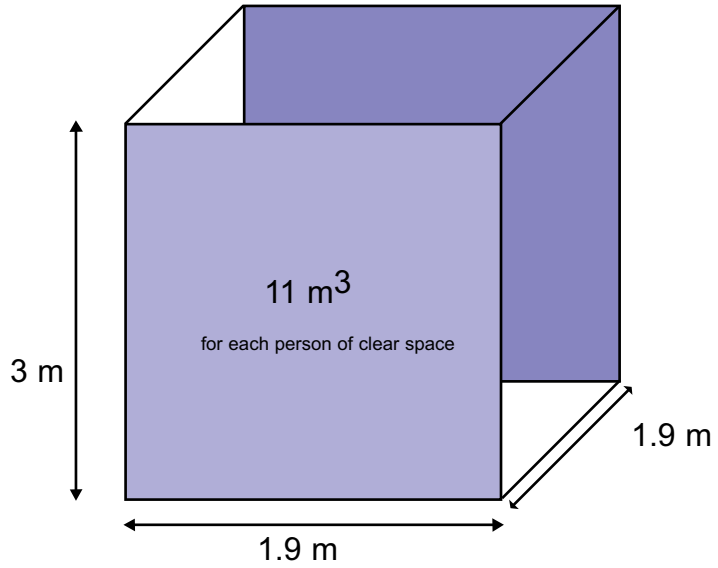
# Room Dimensions and Space – Regulation 10

Workrooms should have enough free space to allow people to get to and from workstations and to move within the room, with ease. The number of people who may work in any particular room at any one time will depend not only on the size of the room, but on the space taken up by furniture, fittings, equipment, and on the layout of the room.

The ACoP defines free space as the total volume of the room, when empty, divided by the number of people normally working in it should be at least 11 cubic metres.

In making this calculation a room or part of a room which is more than 3.0 m high should be counted as 3.0 m high. The figure of 11 cubic metres per person is a minimum and may be insufficient if, for example, much of the room is taken up by furniture, etc.

**Figure 4: Room Dimensions**




The figure of 11 cubic metres does not apply to:

- retail sales kiosks, attendants' shelters, machine control cabs or similar small structures, where space is necessarily limited; or
- rooms being used for lectures, meetings and similar purposes.

In a typical room, where the ceiling is 2.4 m high, a floor area of 4.6 $m^2$ (for example 2.0 x 2.3 m) will be needed to provide a space of 11 $m^3$.

# Workstations and Seating – Regulation 11

Every workstation should be arranged so that it is suitable both for any person at work and for any work done. Every outdoor workstation should be arranged that, so far as is reasonably practicable, it provides protection from adverse weather, it enables any person at the workstation to leave it swiftly or, as appropriate, to be assisted in the event of an emergency, and it ensures that any person at the workstation is not likely to slip or fall.

# Condition of Floors and Traffic Routes – Regulation 12

‘Traffic route’ means a route for pedestrian traffic, vehicles, or both, and include any stairs, fixed ladder, doorway, gateway, loading bay or ramp.

Floors and traffic routes should be sound and strong enough for the loads placed on them and the traffic expected to use them. The surfaces should not have holes, be uneven or slippery and should be kept free of obstructions.

Any holes, bumps or uneven areas resulting from damage or wear and tear, that may cause a person to trip or fall, should be rectified straight away. Adequate precautions should be taken in the short term in the form of barriers or markings to prevent accidents occurring.

Surfaces of floors and traffic routes which are likely to get wet or to be subject to spillages should be made of a type which does not become unduly slippery. A slip-resistant coating should be applied where necessary i.e. floors near to machinery such as a woodworking or grinding machine should be slip-resistant and kept free from slippery substances and / or loose materials.

Where a leak or spillage occurs and it is likely to be a slipping hazard, immediate steps should be taken to fence it off, mop it up, or cover it with absorbent granules.

Floors and traffic routes should be kept free of obstructions which may present a hazard or impede access. This is particularly important on or near stairs, steps, escalators and moving walkways, in or near doorways or gangways, and in any place where an obstruction is likely to cause an accident, for example near a corner or junction.

A secure handrail should be provided and maintained on at least one side of every staircase and both sides where there is a particular risk of falling, i.e. where stairs are wide or have narrow treads. Additional handrails should be provided down the centre of particularly wide staircases where necessary.

# Falls or Falling Objects – Regulation 13

So far as is practicable, every tank, pit or structure where there is a risk of a person in the workplace falling into a dangerous substance must be securely covered or fenced. Also every traffic route over, across or in an uncovered tank, pit or structure should be securely fenced.

A dangerous substance is defined in the regulation as being:

- any substance likely to scald or burn;
- any poisonous substance;
- any corrosive substance;
- any fume, gas or vapour likely to overcome a person; or
- any granular or free-flowing solid substance or any viscous substance which, in any case, is of a nature or quantity which is likely to cause danger to any person.

Every vessel containing a dangerous substance should be adequately protected to prevent a person from falling into it. Vessels installed after the 31st December 1992 should be securely covered, or fenced to a height of at least 1,100 mm unless the sides extend to at least 1,100 mm above the highest point from which people could fall into them. In the case of existing vessels the height should be at least 915 mm.

# Windows, and Transparent or Translucent Doors, Gates and Walls – Regulation 14

Windows, transparent or translucent surfaces in walls, partitions, doors and gates should, where necessary for reasons of health and safety, be made of safety material or be protected against breakage. If there is a danger of people coming into contact with it, it should be marked or incorporate features to make it apparent.

Employers will need to consider whether there is a foreseeable risk of people coming into contact with glazing and being hurt. If this is the case, the glazing will need to meet the requirements of the Regulations, for example the requirements of Table 5.

**Table 5: Size and Thickness of Ordinary Annealed Glass to Provide Safety Material**

| Maximum Size | Nominal Thickness |
|---|---|
| 1.10 m x 1.10 m | 8 mm |
| 2.25 m x 2.25 m | 10 mm |
| 3.00 m x 4.50 mm | 12 mm |
| Any size | 15 mm |

# Regulation 15 – Windows, Skylights and Ventilators

Openable windows, skylights and ventilators should be capable of being opened, closed or adjusted safely and, when open, should not be dangerous.

Windows and skylights should be designed so that they may be cleaned safely.

When considering if they can be cleaned safely, account may be taken of equipment used in conjunction with the window or skylight or of devices fitted to the building.

# Ability to Clean Windows, etc. Safely – Regulation 16

Suitable provision should be made so that windows and skylights can be cleaned safely if they cannot be cleaned from the ground or other suitable surface.

Suitable provision includes:

- fitting windows which can be cleaned safely from the inside, e.g. windows which pivot so that the outer surface is turned inwards;
- fitting access equipment such as suspended cradles, or travelling ladders with an attachment for a safety harness; and
- providing suitable conditions for the future use of mobile access equipment, including ladders up to 9 metres long. Suitable conditions are adequate access for the equipment, and a firm level surface in a safe place on which to stand it. Where a ladder over 6 metres long will be needed, suitable points for tying or fixing the ladder should be provided.

# Organisation, etc. of Traffic Routes – Regulation 17

There should be sufficient traffic routes, of sufficient width and headroom, to allow people and vehicles to circulate safely with ease. New buildings should segregate pedestrian and vehicle traffic. Existing buildings (pre 1993) must segregate so far as is reasonably practicable.

Routes should not be used by vehicles for which they are inadequate or unsuitable.

Restrictions should be clearly indicated. Where sharp or blind bends are unavoidable or vehicles need to reverse, measures such as one-way systems and visibility mirrors should be considered. Speed limits should be set. Screens should be provided to protect people who have to work where they would be at risk from exhaust fumes, or to protect people from materials likely to fall from vehicles.

Additional measures need to be taken where pedestrians have to cross or share vehicle routes. These may include marking of routes, provision of crossing points, bridges, subways and barriers.

Loading bays should have at least one exit point from the lower level or a refuge should be provided to avoid people being struck or crushed by vehicles.

# Doors and Gates – Regulation 18

Doors and gates should be suitably constructed and fitted with safety devices if necessary.

Doors and gates which swing both ways, and conventionally hinged doors on main traffic routes should have a transparent viewing panel.

Power operated doors and gates should have safety features to prevent people being struck or trapped and, where necessary, should have a readily identifiable and accessible control switch or device so that they can be stopped quickly in an emergency.

Upward opening doors or gates need to be fitted with an effective device to prevent them falling back. Provided that they are properly maintained, counterbalance springs and similar counterbalance or ratchet devices to hold them in the open position are acceptable.

# Escalators and Moving Walkways – Regulation 19

Escalators and moving walkways should function safely, be equipped with any necessary safety devices and be fitted with one or more emergency stop controls which are easily identifiable and readily accessible.

# Welfare Facilities

Regulations 20 to 25 cover ‘Welfare facilities’ , which is a wide term, embracing both sanitary and washing accommodation at workplaces, provision of drinking water, clothing accommodation (including facilities for changing clothes) and facilities for rest and eating meals.

# The Health and Safety (Safety Signs and Signals) Regulations 1996

These Regulations require employers to ensure that safety signs are provided (or are in place) and maintained in circumstances where risks to health and safety have not been avoided by other means, for example engineering controls or safe systems of work.

In determining where to use safety signs, employers need to take into account the results of the risk assessment made under The Management of Health and Safety at Work Regulations 1999. This assessment deals with hazard identification, the risks associated with those hazards, and the control measures to be taken. When the control measures identified in the assessment have been taken there may be a 'residual' risk such that employees need to be warned, and informed of any further measures necessary.

These Regulations make it clear that safety signs are not a substitute for other means of controlling risks to employees; safety signs are to warn of any remaining significant risk or to instruct employees of the measures they must take in relation to these risks. For example, in some workplaces:

- risk of flammable materials catching fire may exist. In addition to the other necessary precautions, provision of the 'no smoking' prohibition sign may be needed; and

- there may be a risk of foot injury despite taking measures to control the risk. In this case it may be appropriate to remind staff with the sign indicating that wearing foot protection is mandatory.

Employees should be provided with comprehensible and relevant information, instruction and training on safety signs and signals.

These Regulations do not require safety signs to be used where there are no significant risks to health and safety. Note however, that certain fire safety signs may be specified under quite separate legal provisions.

Safety signs need to contain a pictogram to convey the message instead of relying solely on text.

# Prohibition Signs

These have a white background with a red circular band and crossbar and five symbols are detailed:

- no smoking;
- smoking or naked flames prohibited;
- do not extinguish with water;
- not drinking water; and
- pedestrians prohibited.

# Warning Signs

These have black triangular bands, yellow background with symbol or text in black and a general warning.

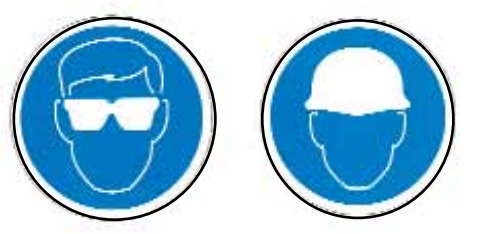
There are ten signs detailed:

- caution, risk of fire;
- caution, risk of explosion;
- caution, toxic hazard;
- caution, corrosive substances;
- caution, risk of ionising radiation;
- caution, overhead load;
- caution, industrial trucks;
- caution, risks of electric shock;
- caution, laser beam; and
- caution, risk of danger.

# Mandatory Signs

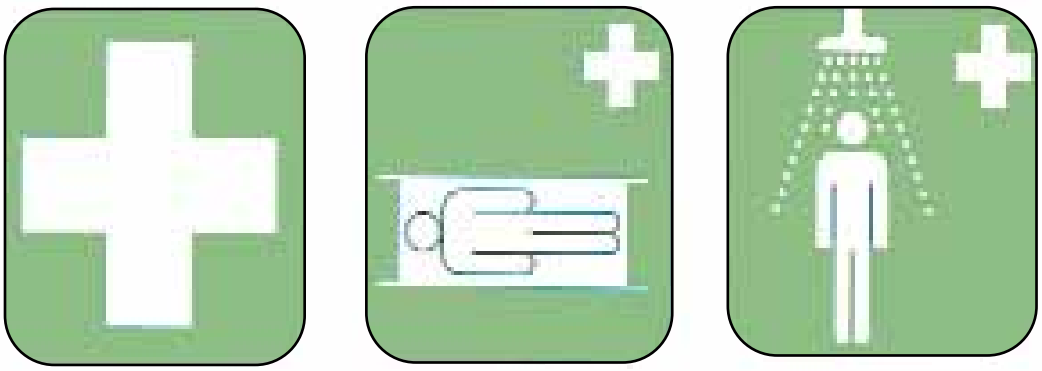
These have a blue circle with symbol or text in white. The listed mandatory signs are:

- eye protection must be worn;
- head protection must be worn;
- hearing protection must be worn;
- respiratory protection must be worn; and
- hand protection must be worn.



# Emergency Escape or First-Aid Signs

These are rectangular or square shape with a white pictogram on a green background (the green part to take up at least 50% of the area of the sign)



# Fire-Fighting Signs

These are rectangular or square shape with a white pictogram on a red background (the red part to take up at least 50% of the area of the sign).

Any supplementary signs must be rectangular or square. Usually they are white with black text but can be the same colour as the background of the associated sign with text in the symbol colour.

Alternative colours of black with fluorescent orange, red or yellow can be used to indicate a place of danger.

In addition, the regulations require the MARKING OF PIPEWORK containing dangerous substances, especially at sample or discharge points. Small stores of dangerous substances also need to be marked in a similar way. The symbols used to label pipework and stores are the same as those used on containers of dangerous substances, using triangular shaped warning signs.

# BS 1710

BS 1710 Specification for identification of pipelines and services provides the detail of the standards required for the labelling of pipework.

It is not only traditional signboards that the regulations apply to, but also other methods of communicating health and safety information.

These include illuminated signs, spoken communication, hand and acoustic signals.

# Illuminated Signs

The sign has to be bright enough to be seen, without causing glare. Care is needed to ensure that a number of illuminated signs are not used together if this could give rise to confusion.

If an illuminated sign can either be on continuously or operate intermittently (i.e. flash on and off), use the flashing sign to indicate a higher level of danger or a more urgent need for intervention or action.

The duration and frequency of flashes for an intermittent illuminated sign need to be such as to ensure the message is properly understood, and avoid any confusion with other illuminated signs, including continuous illuminated signs.

If a flashing sign is used instead of, or together with, an acoustic signal, it is important to synchronise the two. This means that the duration and frequency of flashes need to be in line with both the pulse length and interval for an acoustic signal. The choice of equipment and the way it operates will, of course, need to take account of other risks.

For example, with fast flicker rates epilepsy could be triggered in some people.

Where flashing signs are used to warn of imminent danger, it is particularly important to ensure that measures are in place to either detect failure of the sign quickly or to prevent its failure (e.g. by fitting duplicate bulbs, etc.).

# Acoustic Signals

So that they can be heard, acoustic signals need to be set at a level which is considerably higher in terms of frequency than the ambient noise, for example 10 dB above the level of ambient noise at that frequency. However, make sure the level is neither excessive nor painful. It is also important for signals to be easily recognisable, particularly in terms of pulse length and the interval between pulses or groups of pulses.

Ensure that acoustic signals are not used more than one at a time. If a device can emit an acoustic signal at variable frequencies (this includes an intermittent signal operating on a discrete frequency) or constant frequencies, use the variable frequency set at 10 dB above the ambient level at the appropriate frequency, to indicate a higher level of danger or a more urgent need for intervention or action.

# Hand Signals

Hand signals can be used to direct hazardous operations such as crane or vehicle manoeuvres. Ensure that the signals are precise, simple, easy to make and to understand.

## Codes of Hand Signals

Where hand signals are used ensure they are consistent with the code of signals shown in Schedule 1 of the Regulations or meet either BS 6736 or BS 7121 which are referred to in Schedule 2 of the Regulations.

# Verbal Communication

If verbal communication is used instead of hand signals, use the code words in the table below, and ensure that if the two are used together they are co-ordinated.

**Table 6: List of Approved Words and Actions**

| Code Word | Meaning |
|---|---|
| Start | Start an operation |
| Stop | Interrupt or end an operation |
| End | Stop an operation |
| Raise | Raise a load |
| Lower | Lower a load |
| Forwards | Move forwards |
| Backwards | Move backwards |
| Right | Move to signallers right |
| Left | Move to signallers left |
| Danger | Emergency stop |
| Quickly | Speed up a movement |

# Work in Confined Spaces

A confined space is any space of an enclosed nature where there is a specified risk of serious injury from hazardous substances or conditions within, or nearby, the space.

According to The Confined Spaces Regulations 1997 a specified risk means one or more of the following:

- serious injury due to a fire or explosion;
- loss of consciousness due to increased body temperature;
- loss of consciousness or asphyxiation due to gas, fume, vapour or the lack of oxygen;
- drowning due to an increase in the level of liquid; or
- asphyxiation in a free flowing solid or the inability to reach a respirable environment due to entrapment by a free flowing solid.

Every entry into a confined space is potentially hazardous. Accidents in confined spaces are a major source of deaths at work, killing on average 15 people each year in a wide range of industries.

There have been several court cases involving accidents and fatalities in sewers and other confined spaces. In 1998 at Cardiff Crown Court, a record fine was imposed on Neath Port Talbot Council following the deaths of two employees. The judge, John Prosser, said that the accident should never have happened; the dangers of toxic gases associated with sewer work were well known. The case demonstrated the need for employers to carry out, with strict care, the undertaking of such work and that the difficulty and danger must not be underestimated.

At Carsington Reservoir four men, all aged between 20 and 30 and physically fit, died in an open-topped inspection shaft. Naturally evolved carbon dioxide had displaced the oxygen. No tests were made before entry. The first man down collapsed and the three other men climbed down to their deaths in futile attempts to effect a rescue.

Some confined spaces are fairly easy to identify and some may become a confined space only occasionally, perhaps due to the type of work to be undertaken, such as a room during paint spraying.

# The Dangers Associated with Confined Spaces

## Toxic Gas, Fume Or Vapour

Fume may remain from previous processing or as a result of previous storage, or arise from sludge or other deposits disturbed, for example during cleaning. Hydrocarbon vapour may also be present under scale even after cleaning. Fume may also enter the space from adjoining plant that has not been effectively isolated. Gas and fume can build up in sewers, manholes, contaminated ground or leak from behind vessel linings, rubber, lead, brick, etc. Fume and vapour can also be produced by work inside the confined space, for example, welding, flame cutting, lead lining, brush and spray painting, or moulding using glass reinforced plastics, use of adhesives or solvents, or from the products of combustion. They can also occur inside a compartment or space by hot work taking place on the exterior surfaces or enter the space from equipment in use outside the space, such as exhaust fume from mobile plant, especially on construction sites. Plant failure can also cause problems: for example, by the build-up of ammonia if refrigeration plant fails or the potential for accumulation of carbon dioxide in pub cellars following leaks from compressed gas cylinders.

## Oxygen Deficiency

Normal air that we breathe contains about 21% oxygen. A fall to 17% brings on the start of ill effects including loss of co-ordination, concentration and abnormal fatigue. A fall to 10% brings on breathing difficulties, unconsciousness and death.

Oxygen deficiency may result from, for example:

- purging of the confined space with an inert gas to remove flammable or toxic gas, fume, vapour or aerosols; naturally occurring biological processes consuming oxygen, which can occur in sewers, storage tanks, storm water drains, wells, etc. Similarly gases can be produced as a result of fermentation in sealed silos where crops have been or are being stored; in fermentation vessels in brewing; or in cargo holds caused by the carriage of timber or timber products, steel turnings or swarf, vegetable products, grain, coal, etc.; leaving a vessel completely closed for some time (particularly one constructed of steel) since the process of rust formation on the inside surface consumes oxygen. Newly fabricated or shot blasted carbon steel vessels are especially vulnerable to rusting, particularly those with a large surface area, for example, heat exchangers, separators, filters, etc.; the risk of increased levels of carbon dioxide from limestone chippings associated with drainage operations when they get wet;
- burning operations and work such as welding and grinding which consume oxygen;
- displacement of air during pipe freezing, for example, with liquid nitrogen; or
- a gradual depletion of oxygen as workers breathe in confined spaces and where provision of replacement air is inadequate.

# The Ingress or Presence of Liquids

Liquids can flow into the confined space and lead to drowning and other serious injury depending on the nature of the liquids such as their corrosivity or toxicity.

# Solid Materials Which Can Flow

Free flowing solids can submerge a person, preventing breathing. Materials which create this hazard include grain, sugar, flour, sand, coal dust and other substances in granular or powder form.

# Presence of Excessive Heat

This can lead to a dangerous rise in core body temperature and can be made worse as a result of personal protective equipment being worn. In extreme cases heat stroke and unconsciousness can result. A slower heat build-up in the body can cause heat stress, and if action is not taken to cool the body there is also a risk ofheat stroke and unconsciousness.

# Where Do Confined Spaces Occur?

Some confined spaces are fairly easy to identify, such as closed tanks, vessels and sewers. Others are less obvious such as open-topped tanks and vats, closed and unventilated or inadequately ventilated rooms and silos. A ‘confined space’ may also include: trunking ducts, watercourses, culverts, tunnels, bore-holes, bored piles, manholes, shafts, excavations, sumps, vehicle inspections pits in garages, vehicle production tracks, cofferdams, freight containers, ship cargo holds / tanks.

# What Does the Law Require?

The Confined Spaces Regulations 1997 and associated Approved Code of Practice (ACoP) and guidance came into force on 28 January 1998. These regulations introduce a management framework to minimise and control entry into confined spaces and the key requirements of these regulations are summarised below.

The confined spaces regulations require that:

- employers should avoid the need for entry wherever possible;
- if entry is required, then a suitable and sufficient risk assessment will berequired taking into account the following factors:
- the atmosphere;
- gas purging safe systems of work;
- supervision;
- competence for confined spaces working;
- communications;
- testing / monitoring;
- ventilation;
- removal of residues;
- isolation from gases, liquids and other flowing materials;
- isolation from mechanical and electrical equipment;
- selection and use of suitable equipment;
- personal protective equipment (PPE) and respiratory protective equipment (RPE);
- portable gas cylinders and internal combustion engines;
- gas supplied by pipes and hoses;
- access and egress;
- fire prevention;
- lighting;
- ignition sources, e.g. static electricity and smoking; and
- limited working time.

Additionally there are requirements for:

- emergencies and rescue; and
- training.

# What Issues Should Be Managed For Confined Space Entry?

## Development of a Safe System of Work

The priority when carrying out a confined space risk assessment is to identify the measures needed so that entry into the confined space can be avoided. If it is not reasonably practicable to prevent work in a confined space the employer (or the self-employed) must assess the risks connected with persons entering or working in the space and also to others who could be affected by the work. The assessor(s) must understand the risks involved, be experienced and familiar with the relevant processes, plant and equipment and be competent to devise a safe system of working.

If, in the light of the risks identified, it cannot be considered reasonably practicable to carry out the work without entering the confined space, then it will be necessary to secure a safe system for working. The precautions required to create a safe system of work will depend on the nature of the confined space and the hazards identified during the risk assessment.

## Use of a Permit-To-Work Procedure

Not all work involving confined spaces requires the use of a permit-to-work system.

For example, it is unlikely that a system would be needed where:

- the assessed risks are low and can be controlled easily;
- the system of work is very simple; and
- it is known that other work activities being carried out cannot affect safe working in the confined space.

Although there is no set format for a permit system, it is often appropriate to include certain information relevant to all confined space working. In all cases, it is essential that a system be developed which ensures that:

- the people working in the confined space are aware of the hazards involved and the identity, nature and extent of the work to be carried out;
- there is a formal and methodological system of checks undertaken by competent people before the confined space is entered and which confirms that a safe system of work is in place; and
- other people and their activities are not affected by the work or conditions in the confined space.

Isolation requirements, that is the need to isolate the confined space to prevent dangers arising from outside, should also be included in the permit system. Permits are particularly appropriate if essential supplies and emergency services, such as sprinkler systems, communications, etc., are to be disconnected. The most effective isolation technique is to disconnect the confined space completely by removing a section of pipe or duct and fitting blanks. Other methods include the use of blinds and lockable valves.

# Respiratory Protective Equipment

Where Respiratory Protective Equipment (RPE) is provided or used in connection with confined space entry or for emergency or rescue, it should be suitable for the purpose for which it is intended, that is, correctly selected and matched both to the job and the wearer.

Where the intention is to provide emergency breathing apparatus to ensure safe egress or escape, or for self-rescue in case of emergency, the type commonly called an ‘escape breathing apparatus’ or ‘self-rescuer’ (escape set) may be suitable. These types are intended to allow time for the user to exit the hazard area.

They are generally carried by the user or stationed inside the confined space, but are not used until needed.

In some circumstances entry without the continuous wearing of breathing apparatus may be possible. Several conditions must be satisfied to allow such work including:

- a risk assessment must be done and a safe system of work in place including all required controls, and continuous ventilation; and
- any airborne contamination must be of a generally non-toxic nature, or present in very low concentrations well below the relevant workplace exposure limits.

# Planning an Entry into Confined Spaces Competence for Confined Space Working

The competent person carrying out the risk assessment for work in confined spaces will need to consider the suitability of individuals in view of the particular work to be done.

Examples:

- suitable build of individuals for exceptional constraints in the physical layout of the space (this may be necessary to protect both the individual and others who could be affected by the work to be done); and
- medical fitness concerning claustrophobia or the wearing of breathing apparatus.

# Procedures and Written Instructions

To be effective a safe system of work needs to be in writing, in the form of written instructions, setting out the work to be done and the precautions to be taken. Each procedure should contain all appropriate precautions to be taken and in the correct sequence.

In particular, procedures for confined space working should include instructions and guidance for:

- first-aid — the availability of appropriate first-aid equipment for emergencies until professional medical help arrives;
- first-aiders — the strategic positioning of trained personnel to deal with foreseeable injuries;
- limiting working time — for example, when respiratory protective equipment is used, or when the work is to be carried out under extreme conditions of temperature and humidity;
- communications — arrangements to enable efficient communication between those working inside the confined space and others to summon help in case of emergency;
- engine driven equipment — rules regarding the siting of such equipment, which should be well away from the working area, and downwind of any ventilator intakes;
- water surges — especially the anticipation that sewers can be affected over long distances by water surges, for example following sudden heavy rainfall upstream of where the work is being carried out;
- toxic gas, fume or vapours — procedures to ensure that work can be undertaken safely to include the availability of additional facilities and arrangements where residues may be trapped in sludge, scale or other deposits, brickwork, or behind loose linings, in liquid traps, joints in vessels, in pipe bends, or in other places where removal is difficult;
- testing / monitoring the atmosphere — procedures for the regular testing for hazardous gas, fume or vapour or to check the concentration of oxygen before entry or re-entry into the confined space;

- gas purging — the availability of suitable equipment to purge the gas or vapour from the confined space;

- ventilation requirements — the provision of suitable ventilation equipment to replace oxygen levels in the space, and to dilute and remove gas, fume or vapour produced by the work; and

- lighting — to ensure that the confined space is well lit. Lighting equipment, including emergency lighting, must be suitable for use in flammable or potentially explosive atmospheres.

Generally all lighting to be used in confined spaces should be protected against knocks – for example, by a wire cage – and be waterproof. Where water is present in the space, suitable plug / socket connectors capable of withstanding wet or damp conditions should be used and protected by residual current devices (RCDs) suitable for protection against electric shock.

The position of lighting may also be important, for example to give ample clearance for work or rescue to be carried out unobstructed.

# Fire Prevention and Protection Procedures

Where work involving a dangerous substance takes place in a confined space, the requirements of the Confined Spaces Regulations will apply in addition to the requirements of The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).

The presence of flammable substances and oxygen enrichment in a confined space creates a serious hazard to workers inside the space. There is also a risk of explosion from the ignition of airborne flammable contaminants. In addition, a fire or explosion can be caused by leaks from adjoining plant or processes and the use of unsuitable equipment.

There are many fire precautions necessary for safe working in confined spaces; some of the more important of these are outlined below:

- fire prevention measures - procedures to ensure that no flammable or combustible materials are stored in confined spaces that have not been specifically created or allocated for that purpose. In any event, the quantity of the material should be kept to a minimum and stored in suitable fire-resistant containers;

- fire protection and fire-fighting equipment - procedures to ensure the availability of appropriate fire-fighting equipment where the risk of fire has been identified. In some situations, a sprinkler system may be appropriate;

- smoking - procedures to ensure the prohibition of all smoking within and around all confined spaces; and

- static electricity - procedures to ensure that the build-up of static in a confined space is minimised. It may be necessary to obtain specialist advice regarding insulating characteristics (for example, most plastics), steam or water jetting equipment and clothing containing cotton or wool, flowing liquids or solids, such as sand.

# Supervision and Training

It is likely that the risk assessment will identify a level of risk requiring the appointment of a competent person to supervise the work and ensure that the precautions are adhered to.

Competence for safe working in confined spaces requires adequate training – in addition, experience in the particular work involved is essential. Training standards must be appropriate to the task, and to the individuals' roles and responsibilities as indicated during the risk assessment.

# Access and Egress

A safe way in and out of the confined space should be provided and, wherever possible, allow quick, unobstructed and ready access. The means of escape must be suitable for use by the individual who enters the confined space so that they can quickly escape in an emergency. Suitable means to prevent access should also be in place when there is no need for anybody to work in the confined space.

To satisfy the safe system requirements it is necessary to plan the work thoroughly and to organise various facilities and arrangements. For a large confined space and multiple entries, a logging or tally system may be necessary in order to check everyone in and out and to control duration of entry. A safety sign that is clear and conspicuous to prohibit unauthorised entry alongside openings that allow for safe access should be displayed.

# Cleaning

There are a variety of methods of cleaning the inside of confined spaces to remove hazardous solids, liquids or gases:

- cold water washing;
- hot water washing;
- steaming; and
- solvents or neutralising agents.

# Purging and Ventilation

Air purging and ventilation may be carried out by removing covers, opening inspection doors, etc. and allowing ordinary air circulation, or by the introduction of compressed air via an air line. Higher rates of air exchange can be achieved by the use of air movers, induction fans or extractor fans. It is especially important that when an inert gas (e.g. nitrogen) has been used to purge or render inert a flammable atmosphere, the inert gas itself is properly purged with air. Control measures should aim to keep flammable atmospheres below Lower Explosion Limits (LEL).

# Atmosphere Testing and Monitoring

Before entry is made into a confined space, tests must be carried out to establish the levels of oxygen, toxic gas or flammable gas in the atmosphere. Suitably trained and qualified personnel may use simple, reliable instruments to measure oxygen and flammable gas levels.

A satisfactory oxygen content must not in itself be relied upon to indicate safety since flammable, explosive or toxic gas may exist alongside oxygen and need only be present in minute quantities to create a serious hazard. The tests should take account of what the space is known to have contained, including any inert gas used to purge a flammable atmosphere that may itself produce toxic hazards or the risk of asphyxiation.

Methane, hydrogen sulphide and carbon dioxide can all evolve naturally due to the decomposition of organic matter or, in some cases, by the effect of rainwater percolating through certain types of ground. The initial monitoring and testing must establish that the confined space is safe to enter. To ensure the safety of those that enter the space continual monitoring may be required, it may also be necessary to issue individual monitors to those that enter the confined space to give instant warning of low oxygen, or toxic or flammable gas hazards.

# Emergency Arrangements and Procedures

The arrangements for the rescue of persons in the event of an emergency must be suitable and sufficient and, where appropriate, include rescue and resuscitation equipment. The arrangements should be in place before any person enters or works in a confined space.

The arrangements should cover any situation requiring the recovery of a person from a confined space, for example incapacitation following a fall.

# Openings for Rescue Purposes

Experience has shown that the minimum size of an opening to allow access with full rescue facilities including self-contained breathing apparatus is 575 mm diameter.
This size should normally be used for new plant, although the openings for some confined spaces may need to be larger depending on the circumstances, for example to take account of a fully equipped employee, or the nature of the opening.

# Public Emergency Services

In some circumstances, for example where there are prolonged operations in confined spaces and the risks justify it, there may be advantage in prior notification to the local emergency services before the work is undertaken. In all cases, however, arrangements must be in place for the rapid notification of the emergency services should an accident occur. On arrival, the emergency services should be given all known information about the conditions and risks of entering and / or leaving the confined space before a rescue is attempted.

# Emergency and Rescue Training

To be suitable and sufficient the arrangements for training site personnel for rescue and resuscitation should include consideration of:

- rescue and resuscitation equipment;
- raising the alarm and rescue;
- safeguarding the rescuers;
- fire safety;
- control of plant; and
- first-aid.

Regular refresher training in the emergency procedures is essential and practice drills including emergency rescues will help to check that the size of openings and entry procedures are satisfactory.

The risk assessment may indicate that at least one person, dedicated to the rescue role, should be stationed outside the confined space to keep those inside in constant direct visual sight.

All members of rescue parties should be trained in the operation of appropriate fire extinguishers, which should be strategically located at the confined space. In some situations, a sprinkler system may be appropriate. In all cases, in the event of a fire the local fire service should be called in case the fire cannot be contained or extinguished by first-aid measures.

The training syllabus should include the following, where appropriate:

- the likely causes of an emergency;
- rescue techniques and the use of rescue equipment, for example breathing apparatus, lifelines, and where necessary a knowledge of its construction and how it works;
- the checking procedures to be followed when donning and using breathing apparatus — the checking of correct functioning and / or testing of emergency equipment (for immediate use and to enable specific periodic maintenance checks);
- identifying defects and dealing with malfunctions and failures of equipment during use;
- works, site or other local emergency procedures including the initiation of an emergency response;
- instruction on how to shut down relevant plant as appropriate (this knowledge would be required by anyone likely to perform a rescue);
- resuscitation procedures and, where appropriate, the correct use of relevant ancillary equipment and any resuscitation equipment provided (if intended to be operated by those receiving emergency rescue training);
- emergency first-aid and the use of the first-aid equipment provided; and
- liaison with local emergency services in the event of an incident, providing relevant information about conditions and risks, and providing appropriate space and facilities to enable the emergency services to carry out their tasks.

# Safety Equipment and Tools

## Rescue Equipment

When safety harness and lines are provided, it is essential that proper facilities to secure the free end of the line are available. In most cases the line should be secured outside the entry to the confined space. Lifting equipment may be necessary and the harness should be of suitable construction, and made of suitable material to recognised standards capable of withstanding both the strain likely to be imposed, and attack from chemicals.

## Maintenance of Safety and Rescue Equipment

All equipment provided or intended to be used for the purposes of securing the health and safety of people in connection with confined space entry or for emergency or rescue, should be maintained in an efficient state, in efficient working order and in good repair. This should include periodic examination and testing as necessary. Some types of equipment, for example breathing apparatus, should be inspected each time before use.

Atmospheric monitoring equipment – and special ventilating or other equipment provided or used in connection with confined space entry – needs to be properly maintained by competent persons. It should be examined thoroughly, and where necessary calibrated and checked at intervals in accordance with recommendations accompanying the equipment or, if these are not specified, at such intervals determined from the risk assessment.

Records of the examination and tests of equipment should normally be kept for at least five years. The records may be in any suitable format and may consist of a suitable summary of the reports. Records need to be kept readily available for inspection by the employees, their representatives, or by inspectors appointed by the relevant enforcing authority or by employment medical advisers.

# Equipment for Use in Explosive Atmospheres

When selecting equipment for use in confined spaces where an explosive atmosphere may be present, the requirements of the EU-originated Regulations – Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 – must be complied with. These Regulations apply to ‘equipment’ and ‘protective systems’ intended for use in potentially explosive atmospheres.

Some of the terms used in the Regulations are defined below:

- equipment means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy or the processing of material and which are capable of causing an explosion through their own potential sources of ignition;

- protective systems means design units which are intended to halt incipient explosions immediately and / or to limit the effective range of explosion flames and explosion pressures; protective systems may be integrated into equipment or separately placed on the market for use as autonomous systems;

- devices means safety devices, controlling devices and regulating devices intended for use outside potentially explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems with respect to the risks of explosion; and

- explosive atmosphere means the mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

# Selection and Use of Equipment

All equipment must bear the approved CE mark properly fixed in accordance with the requirements of the 1996 Regulations.

Any equipment provided for use in a confined space needs to be suitable for the purpose. Where there is a risk of a flammable gas seeping into a confined space, which could be ignited by electrical sources (for example a portable hand lamp), specially protected electrical equipment must be used.

To be suitable, the equipment should be selected on the basis of its intended use – proper earthing is essential to prevent static charge build-up; mechanical equipment may need to be secured against free rotation, as people may tread or lean on it.

# Structural Safety of Workplaces

## Introduction

All workplaces are required to be maintained in a suitable and sufficient state. Over time the fabric of the buildings can deteriorate. Those persons such as building owners, those responsible for building maintenance, surveyors, architects, local authority building control officers, estate agents, those with statutory responsibility for historic buildings, etc., must be able to carry out evaluations and inspections of certain traditional buildings and structures.

The main causes of problems in buildings and structures are age and lack of routine building maintenance. Problems may also result from:

- poor design not allowing for maintenance access;
- poor quality building materials;
- poor quality construction standards;
- settlement or other types of foundation failures;
- accidental impact damage to the structural fabric due to moving plant;
- persistent ingress of rain water causing rot and other damage;
- damage to the structure due to misuse, for example overloading;
- damage due to particularly hot or corrosive atmospheres;
- damage due to wood boring insects in timber structures;
- change of use of the building or structure leading to overloading or loss of strength in the structure;
- flooding;
- high winds;
- vibration damage due to transport or quarry blasting activities; and
- damaging interaction of materials.

Potential site hazards:

- fire and explosion damaged building;
- partial demolition or stripping out;
- confined spaces;
- asbestos or other hazardous material;
- biological hazards;
- dangerous animals;
- building utilities; and
- overhead cables.

# Inspection

Prior to an internal inspection of a structure an external inspection from the perimeter should be carried out in order to check:

- line of the roof ridge;
- plumbness (vertical alignment) of walls and quoins (especially at the eaves);
- state of weather, strong winds, etc. as it may affect unstable areas of the building during the inspection;
- major cracks, particularly at corners;
- missing masonry, roof timbers and roof coverings;
- broken gutters and downpipes; and
- timber lintels at doorways and other openings.

If the building assessment indicates that the building, while defective, is not in imminent danger of collapse then the internal inspection can take place with caution. The following areas may need inspection:

- wall piers;
- bearings to beams and joists;
- tying of cross walls to main walls;
- floors or part floors;
- signs of vandalism and theft;
- roof truss seatings;
- roof tiles and timber integrity;
- walls at roof level;
- gables;
- fire escapes;
- imposed loads; and
- health hazards.

# Inspection Planning

Persons working on their own should not normally carry out surveys and or inspections of workplace structures. If however, work is carried out alone then a system of 'reporting in' should be adopted so that the alarm can be raised if a report is not received at the pre-arranged time(s).

If entry or inspections take place in confined spaces then the Confined Space Regulations should be complied with. A number of issues will need to be looked at during the planning stage and may include:

- clothing: Depending on the conditions such as dirty or wet areas, dust masks, safety helmet and boots;
- equipment: Flashlight, camera, binoculars, ladder or lightweight staging, moisture reading instrument and pocket knife;
- previous reports: If available for previous inspections / surveys;
- building history: How long it has been standing, what it has contained in the past, past works undertaken on the structure; and
- specialist assistance: There may be a requirement to have structural engineers, chemists or occupational hygienists for sampling or checking on specific matters.

# Structural Deterioration

Most problems of deterioration found within buildings are those caused by movement and adverse weather conditions.

# Structural Damage

Structural damage may be caused in a variety of ways such as:

- adverse weather conditions;
- overloading or deliberate alterations to structural members;
- unauthorised modifications to buildings;
- hot and corrosive atmospheres;
- reciprocating or vibrating motions of plant or machinery can lead to harmonic motion in structural members and lead to a collapse;
- alteration to structural members;
- subsidence;
- deterioration of building materials;
- excavations; and
- accidental impact from vehicles, particularly at openings and corners of buildings.

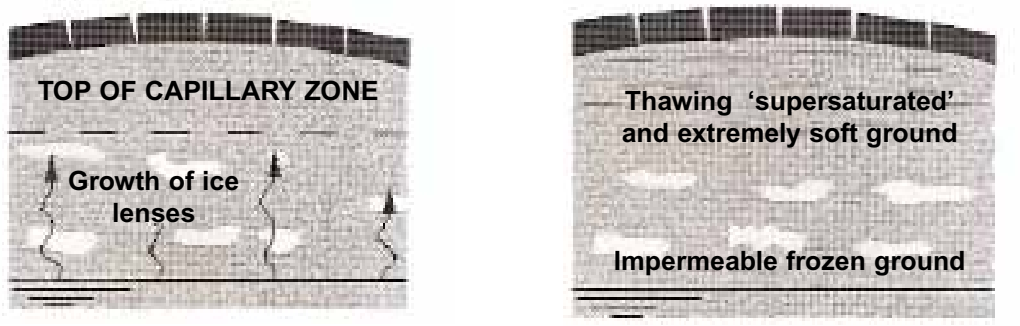
Other possible causes of structural alterations such as cutting roof beams, puncturing holes through floors, removal of internal walls etc can also lead to collapse.

# Other Problems

Depending on the type of construction or building materials used, a number of other problems within structures may be found as follows:

- temperature variations may affect structures more than 40 m in length at roof levels or the storey below the roof, which is manifested by cracking and loosening of brickwork panels in framed structures;

**Figure 6: Example of Frost Heave**




- walls may be subject to 'frost heave' which is a condition where the freezing of the ground and 'growth' of ice lenses in the soil causes the ground surface to heave;
- some special brick structures may be vulnerable due to their particular use, such as kilns and ovens where high temperatures and subsequent cooling produce a substantial degree of movement in the structure;
- dry rot;
- wet rot;
- insect attack;
- tunnelling by vermin;
- softening of the ground from roof drainage may lead to unequal settlement cracking of walls;
- erosion of soil due to rainwater run-off, which undermines shallow foundations leading to tilting of walls and piers;
- removal of trees in shrinkable clays;
- damaged land drains, inspection chambers and soakways; and
- excavations that expose foundations.

Structures that have suffered serious deterioration and where people are at work. Specialist inspectors who are qualified structural and civil engineers have examined in detail many suspect buildings and structures in order to provide detailed advice to owners, occupiers and the enforcement officers on the degree of danger that exists.

Organisations involved in survey work need to ensure that detailed policies and procedures are prepared and that trained competent staff are used to carry out the works.

# Work at Height

## Introduction

Work at height may involve some or all of the following hazards:

- fall of a person, e.g. from a work platform;
- collapse of the work platform;
- falls of objects or materials onto people below; and
- contact with overhead services.

Falls from height remain the most common kind of accident causing fatal injuries. The majority of falls from height occur from:

- ladders, primarily from moveable ladders;
- scaffolding, primarily from general access scaffolds;
- work area / machinery / platform;
- vehicles;
- roof edges;
- fragile roofs;
- stairs; and
- raised walkways.

Falls from height can also occur from falls into unguarded holes in floors, e.g. hatchways, inspections holes and pits, and from falls into process tanks and machinery. The severity of the injury is increased when the fall is into the path of a moving vehicle or machinery or into a container or tank of hazardous substance, e.g. molten metal, granular or free flowing substance, corrosive or toxic substance.

The most common incidents involve over-reaching, over-balancing, equipment failure, misuse of equipment, unexpected movement (particularly where ladders are involved) and the failure of a fragile surface.

All work at height is now covered by a single set of regulations, The Work at Height Regulations 2005. The overriding requirement of the regulations is to prevent, so far as is reasonabably practicable, falls from any place of work, which could lead to injury.

The regulations apply to all work at height where there is a risk of a fall liable to cause personal injury. They place duties on employers, the self-employed, and any person who controls the work of others, e.g. facilities managers or building owners who may contract others to work at height, to the extent they control the work.

# Organisation and Planning – Regulation 4

Every duty holder (employers, self-employed and those in control of the work) should ensure that work at height is:

- properly planned, including emergencies and rescue plans, and in conjunction with regulation 7 when selecting work equipment;
- appropriately supervised; and
- carried out in a manner which is so far as is reasonably practicable safe, ensuring that no adverse weather conditions are present to compromise the safety of persons working at height.

# Competence - Regulation 5

Employers should ensure that those carrying out the work, including those organising, planning or supervising it, are competent.

# Avoidance of Risks from Work at Height - Regulation 6

This requires employers to carry out a risk assessment of the activity under Regulation 3 of The Management of Health and Safety at Work Regulations 1999 (MHSWR), to identify if there is a need to work at height. If it is not reasonably practicable to avoid work at height then the employer must ensure appropriate control measures are in place to protect those involved in the activity. Measures must be taken to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury.

This includes a hierarchy of control measures that include:

- working from an existing place of work, or using an existing means of access and egress that complies with Schedule 1 of the regulations, e.g. be stable, rigid and strong enough for the intended use, etc.;
- provision of suitable work equipment to prevent a fall occurring, e.g. edge protection; and
- provision of work equipment to minimise the distance and consequences of a fall, e.g. fall arrest systems.

People should, as far as possible, avoid climbing on top of vehicles or their loads. If this is not possible, effective measures such as providing fencing should be taken, to prevent falls. If a tanker is loaded from a fixed gantry and access is required onto the top of the tanker, fencing should be provided. Sheeting of lorries should be carried out in properly equipped designated places.

Slips and trips, which may be trivial at ground level, may result in fatal accidents when on a roof. If fencing cannot be provided, or has to be removed, effective measures should be taken to prevent falls. Access should be limited to specified people and in high risk situations suitable formal written ‘permit-to-work’ systems should be adopted.

A safe system of work should be operated, which may include the use of a fall arrest system or safety lines and harnesses and secure anchorage points. Systems which do not require disconnection and re-connection of safety harnesses should be used. If there is no need to approach edges, the length of the line and anchorage position should prevent the edge being approached.

# Selection of Work Equipment for Work at Height - Regulation 7

The employer should give collective measures priority over personal protection when selecting work equipment, and should select suitable equipment that is strong enough for the work and any loads placed on it, taking into account:

- the working conditions and the risks to the safety of persons at the place where the work equipment is to be used;
- in the case of work equipment for access and egress, the distance that has to be negotiated;
- the distance and consequences of a potential fall;
- the duration and frequency of use;
- the need for easy and timely evacuation and rescue in an emergency; and
- any additional risks posed by the use, installation or removal of the work equipment, e.g. the erection and dismantling of scaffold on a busy street.

# Requirements for Particular Work Equipment - Regulation 8

When guard-rails, toe-boards, scaffolding, fall-arrest systems, personal fall protection systems and ladders are provided, these should meet the requirements of the appropriate Schedule of the regulations.

# Fragile Surfaces - Regulation 9

**Figure 7: Fragile Roof**

Every employer should ensure that no person at work should pass or work on or near a fragile surface unless it is not reasonably practicable to carry out the work elsewhere.

Where it is not reasonable practicable to avoid work on or near a fragile surface then:

- suitable protection, such as platforms, coverings, crawling boards, or guard-rails, must be provided; or
- where this is not reasonably practicable, measures should be taken to minimise the distance and consequence of any fall, e.g. fall arrest systems, safety nets and air bags.

Prominent warning signs should be posted at any location where persons may pass near or work on a fragile surface.

# Falling Objects - Regulations 10

Employers should prevent, as far as is reasonably practicable, the fall of objects or material, e.g. toe boards and sheeting on scaffolding. Where this is not reasonably practicable, suitable steps should be taken to ensure that persons are not struck by falling objects, e.g. barrier off danger area below and prevent unauthorised access.

Employers should ensure that, where it is liable to cause injury to any person, no material is dropped from height by the use of chutes, etc. and no material is stored in such a way that it might cause a collapse that could lead to a personal injury.

# Falling Materials

Materials and objects need to be stored and stacked in such a way that they are not likely to fall and cause injury.

Storage racking and shelving needs to be of adequate strength and stability for the loads to be placed on it. In general, racking and shelving is made from lightweight materials and is limited to the amount of wear and tear it can withstand. The skill of workplace transport operators has a great bearing on the amount of damage likely to be caused. The greater the damage to racking and shelving, the weaker it will be, until it may eventually collapse, even when supporting less than its normal working load.

To ensure that racking or shelving installations continues to be serviceable:

- they should be regularly inspected to identify damage and necessary action;
- employees should be encouraged to report any damage, however minor, so that its effect on safety may be assessed; and
- maximum load notices should be displayed and strictly adhered to.

Appropriate precautions in stacking and storing include:

- safe stacking on sound pallets;
- banding or wrapping to prevent individual articles falling;
- setting limits for the height of stacks to maintain stability;
- regular inspection of stacks to detect and remedy any unsafe stacks;
- instruction and training of employees in stacking; and
- special arrangements for objects which may be difficult to store.

# Danger Areas - Regulation 11

Where there is a risk of any person at work falling a distance or being struck by a falling object that is liable to cause personal injury, employers should ensure that the workplace is clearly identified and, so far as is reasonably practicable, equipped with devices preventing access by unauthorised persons.

# Inspection of Work Equipment - Regulation 12

Where the safety of work equipment depends on how it is installed or assembled, e.g. scaffolding, it should be inspected in place before it is used.

Where work equipment is exposed to conditions causing deterioration that could lead to a dangerous situation, such as high winds for example, it should be inspected at suitable intervals and each time exceptional circumstances occur that could jeopardise its safety.

There are specific requirements for the inspection of equipment used in construction sites, these are dealt with in Element C9.

# Inspection of Places of Work at Height - Regulation 13

Every employer should, so far as is reasonably practicable, ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used.

# Duties of Persons at Work - Regulation 14

This requires those working at height to report to the person controlling the work any activities or defects in relation to work at height that are unsafe.

Persons at work are also required to use any work equipment or safety advice in accordance with any training or instruction provided.

# Schedules to The Work at Height Regulations 2005

## Schedule 1: Existing Places of Work and Means of Access / Egress

Under Schedule 1, existing places of work and means of access or egress at height should:

- be stable and of sufficient strength and rigidity for purpose;
- rest on stable and a suitably strong surfaces;
- be of sufficient size to allow safe use for persons, plant and material;
- have suitable means for preventing a fall;
- have a surface which has no gap through which a person or material could fall and cause injury; and
- be constructed, used and maintained to prevent the risks of slipping, tripping or any person being trapped between them and any adjacent structure.

## Schedule 2: Collective Means of Protection

This Schedule lists the requirements for guard-rails, toe-boards, barriers and similar collective means of protection. Such means of protection should:

- be of sufficient dimensions, strength and rigidity for purpose;
- be placed and secured so that they do not become accidentally displaced; and
- be placed to prevent the fall of any person or any object.

In addition, supporting structures for means of protection should be of sufficient strength and fit for purpose; there must not be any gaps in the means of protection apart from access points for ladders or stairways; and means of protection should only be removed as necessary to gain access for particular tasks and should be replaced as soon as practicable. When barriers, etc. are removed in this way, the task should not be performed until the barriers, etc. have been replaced.

The remaining Schedules to the Regulations cover:

- Schedule 3: Working Platforms;
- Schedule 4: Collective Safeguards for Arresting Falls;
- Schedule 5: Personal Fall Protection Systems; and
- Schedule 6: Ladders.

# Lone Working

Current legislation does not specifically disallow lone working, except in a few specific instances where employers need to be aware of the specific law on supervision, e.g. diving operations, in vehicles carrying explosives and fumigation work.

Lone workers are those who work by themselves without close or direct supervision and are found in a wide range of situations, e.g.:

# On Site

- only one person works on the premises, e.g. in small workshops, petrol stations, kiosks, shops and home workers;
- people work separately from others, e.g. in factories, warehouses, training establishments, leisure centres etc; and
- people work outside normal hours, e.g. cleaners, security, special production, maintenance or repair staff, etc.

# Off Site (Peripatetic or Mobile Workers)

- on construction, plant installation, maintenance and cleaning work,
- electrical repairs, lift repairs, vehicle recovery, etc;
- agricultural and forestry workers; and
- service workers, e.g. rent collectors, postal staff, social workers, home helps, district nurses, drivers, estate agents, sales representatives and similar professionals who visit customer and client premises.

# Risk Assessment and Lone Working

Lone working is subject to the general requirement for risk assessment under regulation 3 of The Management of Health and Safety at Work Regulations 1999.

As such the standard Five Steps approach is appropriate.

The following specific issues will need to be addressed in the risk assessment:

- Does the workplace present a special risk to the lone worker?
- Are the potential consequences of injury increased due to working alone?
- (Consider emergency arrangements, first-aid cover, etc.).
- Is there safe access and egress?
- Can any temporary access equipment, e.g. ladders, be safely handled by one person?
- Can all the plant, substances and goods involved in the work be safely handled by one person?

- Does the work involve lifting objects too large for one person?
- Is there a risk of violence?
- Are women especially at risk if they work alone?
- Are young workers especially at risk if they work alone?

# Safe Working Arrangements for Lone Workers

Some of the issues which need special attention when planning safe working arrangements for lone workers are as follows:

- check that lone workers have no medical conditions which make them unsuitable for working alone;
- training is particularly important where there is limited supervision to control, guide and help in situations of uncertainty;
- training may be critical to avoid panic reactions in unusual situations;
- lone workers need to be sufficiently experienced and to understand the risks and precautions fully; and
- employers should set the limits to what can and cannot be done while working alone. They should ensure employees are competent to deal with circumstances which are new, unusual or beyond the scope of training, e.g. when to stop work and seek advice and how to handle aggression.

# Supervision of Lone Workers

The extent of supervision required depends on the risks involved and the ability of the lone worker to identify and handle health and safety issues.

There are some high-risk activities where at least one other person may need to be present. Examples include confined space working where a supervisor may need to be present, as well as someone dedicated to the rescue role, and electrical work at or near exposed live conductors where at least two people are sometimes required.

The level of supervision required is a management decision which should be based on the findings of risk assessment. The higher the risk, the greater the level of supervision required. It should not be left to individuals to decide whether they require assistance.

Procedures will need to be put in place to monitor lone workers to see they remain safe. These may include:

- periodically visiting and observing people working alone;
- regular contact between the lone worker and supervision using either a telephone or radio;
- automatic warning devices that operate if specific signals are not received periodically from the lone worker;
- other devices designed to raise the alarm in the event of an emergency and which are operated manually or automatically by the absence of activity;
- checks that a lone worker has returned to their base or home on completion of a task;
- emergency procedures should be established and employees trained in them; and
- lone workers should have access to adequate first-aid facilities and mobile workers should carry a first-aid kit suitable for treating minor injuries.

# References

The Workplace (Health, Safety and Welfare) Regulations 1992, ACoP L24, HSE Books, 2001.

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