

OCCUPATIONAL SAFETY

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Contents

1. Introduction
2. Preventing Accidents at Work
3. Workplace Safety, Moving Goods and Materials, Transport and Driving for Work
 - 3.1. Slips and Trips
 - 3.2. Work at Height
 - 3.3. Safety in Use of Fork Lift Trucks and On-site Vehicles
 - 3.4. Cranes and Lifting Operations
 - 3.5. Safety in Road Transport and Managing Road Risk
 - 3.6. Heavy Goods Vehicles
4. Construction and Demolition Hazards
 - 4.1. Work at Height and Safe Use of Scaffold Systems
 - 4.2. Excavations
 - 4.3. Avoiding Contact with Services
 - 4.4. Preventing Excavation Collapse
 - 4.5. Controlling Other Excavation Hazards
5. Outdoor Working
 - 5.1. Working Outside in the Cold
 - 5.2 Working Outside in Hot Weather
6. Safety in the Use of Work Equipment
 - 6.1. Inspection Regimes
 - 6.2. Hand-held Tools and Equipment
 - 6.3. Machinery Hazards and Controls
 - 6.4. Pressure Systems
7. Electricity
 - 7.1. Hazards of Electricity
 - 7.2. Controlling Electrical Hazards
 - 7.3. Safe Working with Electrical Systems
8. Fire Safety
 - 8.1. Combustion
 - 8.2. Fire Triangle
 - 8.3. Characteristics of Fire
 - 8.4. Assessing Fire Risk in the Workplace
 - 8.5. Fire Detection, Alarms and Fire Fighting
 - 8.6. Protecting People in the Event of a Fire
9. Chemical Safety
10. Fire and Explosion

- 10.1. Explosions
- 10.2. Controlling Sources of Ignition
- 10.3. Static Electricity
- 10.4. Substances which in Themselves Pose a Hazard
- 11. The Storage of Hazardous Goods
- 11.1. Dealing with Spillages
- 12. Confined Spaces
- 13. Permit to Work Systems
- 13.1. Lock out Tag out Procedures
- Conclusions
- Glossary
- Bibliography
- Biographical Sketch

Summary

Prevention of accidents at work requires the systematic identification of hazards, evaluation of risk and the development of control measures which are commensurate with that risk. The actual hazards which exist depend upon the working environment, the equipment and materials in use and the skills and experience of the individuals carrying out that work. This chapter reviews some of the most common workplace hazards and the common methods of control of such hazards.

1. Introduction

The ILO estimates that every day more than 7,000 people die from occupational accidents or work related diseases. Worldwide, there are around 374 million occupational accidents each year. The human cost in terms of pain and suffering and economic hardship, is vast. Conditions of work which are likely to lead to accidents vary between different countries, industries and social groups. In developing countries a larger proportion of the population are employed in hazardous industry sectors such as agriculture and mining. Often women, children and migrant workers are particularly vulnerable.

Accidents at work are a cost to business and to national economies. The ILO estimates the economic burden of poor occupational safety and health practices at 3.94% of global Gross Domestic Product (GDP) each year.

2. Preventing Accidents at Work

The causes of accidents will vary according to the type of work being carried out. In many workplaces, the most common type of accident is a fall, with the severity depending often on the height from which the individual falls. Motor vehicles are also responsible for a large number of fatal accidents to people who need to drive as part of their work, or work in vicinity of vehicle movements. Whatever the type of accident, the principles of prevention are the same. They are:

- **Identify hazards**

Simply put, a hazard is a condition which is likely to lead to an accident or harm. It can arise because of the properties of a material, such as it being corrosive, or having sharp edges. It can also arise because of the working environment, such as working in a confined space with lack of adequate ventilation, such as a sewer, or working at a height on a roof, or in an excessively cold situation. Hazards can also arise from machinery working parts and the work activity being carried out, for example working with wood which can generate dust or solvents which can create flammable atmospheres. Unwanted contact with energy, such as heat, electricity or radiation can also present a hazard.

- **Determine** the size of the risk

Risk is the probability of harm occurring and the potential severity of harm which is likely to result. For example, where people are working near the edge of an unguarded roof, the probability of a fall from the roof is fairly high, and if the roof is over around 2 metres, the likelihood is that severe or fatal injuries will result. The purpose of assessing the risk is to determine priorities for prevention, so that resources can be put into controlling significant risks first. This example of working near an unguarded roof edge would obviously present a high risk which needs to be controlled urgently.

- **Develop** Control measures

The measures to control risks should be proportionate to those risks, and should seek to eliminate hazards completely if possible as a first priority. If hazards cannot be eliminated they should be controlled. Control measures should be considered in the following order:

- **Eliminate** the hazard

For example, a hole in the ground can be filled in, and hence the falling hazard will be eliminated altogether.

- Reduce the risk by **Substitution**

For example, a powder ingredient can be replaced with pellets or by pre-dissolving it into a liquid in a chemical process to reduce the generation of dust.

- Reduce the risk by **reducing the amount**

For example controlling the amount of a flammable material stored in the workplace

- Reduce the risk by **reducing the exposure time**

For example ensuring that workers in a cold environment can take breaks in a warmer control room.

- **Isolate** the hazard

The aim is to prevent people from coming into contact with the hazard. An example from a laboratory could be to contain hazardous substances within a glove box. Within a car factory, the production line with robots can be completely fenced off. Flammable gases in cylinders such as liquefied petroleum gases are usually stored in a secured compound.

- Control by **engineering means**

An example is to enclose dangerous parts of a machine with an interlocked guard which will cut the power to the machine and bring moving parts to a stop when the guard is opened. Another example is using a local exhaust ventilation system to reduce the concentration of hazardous substances in the workroom atmosphere.

- Control by using a **safe system of work**

For high hazard work such as entering a confined space this can be a very formal documented work method, controlled using a permit to work system.

- Personal **protective equipment**

Protect the individual against the hazard by the use of protective equipment, such as a face shield or safety spectacles.

- **Disciplined** working

The least effective method of control, which relies on the skill and discipline of the individual to take steps to work safely, for example using woodworking machinery where the only effective guard is one that is adjusted by the operator to fit the work piece.

Control measures that protect everyone in the workplace, such as elimination or isolation of the hazard are always preferable to controls which only protect the individual, such as harnesses or protective clothing. Wherever possible, hazard identification should be considered when a process or activity is being planned so that hazards can be “designed out” and eliminated before they arise.

- **Implement control measures**

This may involve training people in new working methods and assuring their competence to follow safe systems of work.

- **Monitor and review**

It is vital to ensure that any controls put in place actually do control the hazard and do not in themselves create additional problems.

The identification and control of hazards is just one element of an effective management system which sets priorities for health and safety at work, and ensures that the organisation and arrangements are in place to manage it alongside other business activities. A safe workplace is more efficient and far from being a burden on business, sound health and safety management is a key factor in minimising losses and ensuring business success.

3. Workplace Safety, Moving Goods and Materials, Transport and Driving for Work

3.1. Slips and Trips

In most workplaces slips trips and falls represent the greatest cause of accidents and in the past they have often been considered to be a class of accident that is difficult to prevent.

The best starting point is of course good housekeeping. If the workplace is tidy then there is less for people to trip over. Getting rid of, or covering, trailing cables and dealing with leaks and spills promptly can be a great first step in accident reduction.

Keeping floor surfaces clean, dry and grease free can make a huge impact on the number of slips. A proper cleaning regime stops the floor getting dirty and can prevent slips, but if not undertaken carefully the cleaning regime in itself can lead to problems. A wet floor can be a cause of slips so a few precautions are wise. For example:

- Clean outside of normal working hours, where possible
- Use the correct cleaning materials for the floor surface
- Make sure that the floor is completely dry before being used again



Figure 1. Minimising the slipping hazard from wet floors © NEBOSH

Teaching cleaning staff key facts about slips and trips can have a big impact on their behaviour (for example physical demonstrations can be used to show just how slippery a wet floor is.)

If it is possible to influence the design of the workplace then there are many steps that can be taken to minimise future slips and trips such as making sure that the floor and stair surfaces are suitable for the activities planned for that area, particularly if they are likely to get wet. Also make sure that:

- changes in level, surface type or slope are clearly visible and lighting design does not hide floor features
- stairs conform to international standards, have a proper tread depth, even step height and proper marking.

- the type and coverage of entrance matting is sufficient to stop water being carried on to the main body of the flooring
- storage is provided close to areas where items are to be used so that they are easy to put away after use and not left lying around to cause trips.

Finally there have been significant developments in slip resistant footwear in recent years. New tread design and objective testing has led to a revolution in slip resistance. Footwear selection is incredibly important in those areas where there is little or no control over the work environment (such as working on the public highway) and also where surface contamination is possible.

3.2. Work at Height

Falling from height is a major cause of fatalities worldwide. Even falling a relatively small distance can prove fatal if the person lands badly. In fact nearly 90% of those receiving major injuries fall from a height of less than 2 metres.

Some falling risks are obvious, for example the unguarded edge of a roof. Others are less so; for example falling from the edge of a manhole into an underground sewer or falling through a fragile roof. Fragile roof material in particular is a problem, as it is not always easy to identify the fragile elements of a roof when it has been in place for a number of years.

The main control to consider first is to avoid work at height where possible; For example, a window cleaner can use a long pole to clean windows on a higher floor rather than work at height cleaning off a ladder.

If work at height cannot be avoided, then control measures should be put in place to prevent falls. For example permanent barriers can be fixed to the edge of roofs. Guardrails and toe boards should be provided on working platforms and scaffold platforms to prevent people falling, but also to prevent objects being knocked off the platform and injuring those beneath. Where the risk of falling from height is temporary, barriers may be put in place, for example around excavations, or around open manholes.

If it is not possible to prevent falls, then measures to reduce the consequences, such as reducing the distance the individual can fall, must be provided. This may be a safety net or air mattress to cushion or limit a fall where a number of people are working. Where fewer people are working at height, individual protective devices may be more practicable. This normally consists of some form of work positioning system – a restraint that stops an individual walking to a danger area- or a fall arrest device. Fall arrest devices consisting of a harness and lanyard connected to a suitable anchor point are designed to minimise the distance that someone will fall and to some extent take some of the energy out of the fall. This equipment is critical and needs to be regularly inspected.

The use of personal fall protection such as lanyards can make some tasks more difficult and it is for this reason that it is not uncommon for workers to fail to hook their lanyard to the attachment point. Obviously in these cases no protection will exist. It is for this

reason that education is needed on the importance of fall protection and crucially that supervisors never turn a blind eye to this type of occurrence.

Access to heights is also an important factor. If options are available at the design stage, stair cases are safer than fixed ladders, which are in turn safer than temporary access equipment.

Working from ladders is not a practice that should be banned, but their use should be avoided except for activities which are low risk and of short duration, and even then they need to be secured and used correctly.

Using ladders safely:

- Put the ladder up at an angle of 75° or 4 up to 1 out.
- Tie the ladder at the top OR have someone foot the ladder at the bottom
- Try to maintain 3 points of contact when climbing a ladder. If it is necessary to take something up, carry it on a belt or hoist it up afterwards
- If the ladder is being used as a means of access, ensure it runs past the point needed so there is a handhold.



Figure 2. Mobile Elevated Working Platform © NEBOSH

Ladders and stepladders need regular, careful inspections.

On average a third of all reported fall-from-height incidents involve ladders and stepladders – In the UK this accounts for 14 deaths and 1200 major injuries to workers each year. Many of these injuries are caused by inappropriate or incorrect use of equipment

It is difficult to work safely from the top of a ladder. In most cases more stable alternatives such as mobile elevated working platforms (MEWPs), scaffolds or fixed working platforms should be used.

3.3. Safety in Use of Fork Lift Trucks and On-site Vehicles

Another major cause of injury and fatalities is workplace transport. Many workplaces have lorries, vans, cars, motor bikes, lift trucks and pallet trucks moving around the site. Hazards arising from vehicles can include:

- Collision with other vehicles, fixed structures or pedestrians, which can be due to:
 - Reversing, particularly into a restricted space such as a loading bay
 - Poor visibility due to low lighting levels or from moving between brightly lit and darker areas
 - Poor design of racking storage systems
 - Poor design of the workplace, such as blind bends, pedestrian exits opening on to vehicle routes, lack of designated crossing areas, lack of designated parking areas and congestion.
- Loss of control or overturning of vehicles: caused by one of the following or a combination of these factors:
 - Uneven ground, obstructions or potholes,
 - Driving or manoeuvring at excessive speeds
 - Steep slopes
 - Insecure or excessive loads, especially if carried at a height on a forklift truck
 - Human factors such as fatigue and “horseplay”
- Hazards from the vehicles, such as:
 - Falls from the back of a lorry being loaded,
 - Contact with hazardous parts such as rotating drive shafts
 - Being struck by falling loads
 - Explosive gases from battery charging a fork lift truck, or leaking gases from LPG operated lift trucks

To control hazards from vehicles in the workplace four main issues need to be considered:

- The Workplace
- Vehicles
- Drivers
- Safe working methods



Figure 3. A Fork Lift Truck in use in a warehouse

There are some basic precautions that should be considered in the workplace:

- Vehicles and pedestrians should have separate routes as far as possible. Traffic flow systems are only effective if they are clearly marked with direction signs, speed limits and safe crossing points for pedestrians.
- Traffic routes used by people and vehicles should be wide enough to enable vehicles to pass pedestrians safely, and there should be protection for pedestrians by using raised kerbs, barriers and designated crossing places. Within a factory or warehouse where fork lift trucks operate, pedestrian routes can be laid out with paint on the floor.
- The workplace should be designed as far as possible to avoid the need to reverse. This can include one-way systems and clear sign posting of where vehicles are to go.
- Traffic routes should be designed to avoid blind corners. If this is not possible the risk should be managed at blind spots with traffic light systems, blind spot mirrors or signs telling drivers to sound their horns as a warning
- Unnecessary pedestrian access to areas with high traffic volumes such as loading bays should be prohibited. For the people that do need to be there, high visibility clothing should be provided.
- In areas where there are high traffic levels, high levels of reversing or blind spots the traffic may need to be controlled directly through the use of banksmen who are trained to give clear signals to drivers.
- Lighting levels must be adequate for all the times that vehicles are working in an area.
- Floor surfaces should be well maintained and spills must be cleared up appropriately to prevent vehicles skidding. In some parts of the world, in winter, measures to deal adequately with snow and ice to prevent collisions from skidding must be in place before such weather begins.

Safe vehicles:

- Vehicles must be selected to be appropriate for the environment they are being used in. For example, a fork lift truck used on a construction site should be suitable for that terrain.
- Vehicles must be well maintained and subject to routine user checks, particularly of any safety devices on the vehicle such as reversing alarms, mirrors, horn, safe working load indicators etc.
- The various vehicles that are used in the workplace can be powered by a number of fuel sources, the most common being electricity, diesel or gas. Each of these fuel sources has its own hazards, from the explosive hydrogen which is released during the charging of fork lift truck batteries to the fumes which are produced by diesel engines. It is important to be aware of the hazards associated with the particular fuel source that is in use and work appropriately, i.e. eliminate sources of ignition around battery charging bays and prohibit diesel trucks in confined spaces.



Figure 4. Fork lift truck on a construction site © NEBOSH

Drivers need to be selected on the basis that they are physically fit for the job. The operator needs to be able to get on and off the truck easily and needs to have sufficient trunk mobility to be able to perform the operations required to operate a fork lift truck in a busy area. That is they should be able to turn to reverse and to see what is coming. Fork lift truck drivers also need good eyesight so that they can properly judge distance.

Any employees or contractors who use forklift trucks, pallet trucks or similar must be properly trained, to a recognised standard. In many countries there is a formal system for the certification of drivers of certain vehicles.

Even if the driver has been trained, their performance needs to be monitored, and it must be ensured that good driving or vehicle operating practices and site rules such as speed limits are being followed. Driving performance can be impaired by excessive

fatigue, use of alcohol or prescription and non-prescription drugs- and by the use of a mobile phone.

Safe systems of work when operating vehicles will depend on the needs of the workplace and task but can include:

- Driving rules for fork-lift trucks such as not travelling with the load raised or reversing down slopes.
- Site speed limits
- Safe methods for accessing vehicles for maintenance

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Biographical Sketch

Teresa Budworth has been Chief Executive of NEBOSH since 2006. In a career spanning nearly four decades, Teresa has been instrumental in developing health and safety as a profession and improving practitioner competence in countries across the world. A Chartered Safety and Health Practitioner and Fellow of the Institution of Occupational Safety and Health (IOSH), Teresa is also a Certified Risk Professional and a Chartered Director.

She was for nine years as a Visiting Senior Teaching Fellow and member of the Examination Board for post graduate courses in Occupational Health at the University of Warwick's Medical School. In 2017, Teresa was appointed as Chair of the Board of Trustees of the Chief Fire Officers' Association. She is Vice Chair of the Board of OSHCR Ltd, the body running the Occupational Safety and Health Consultants Register, which was established in 2011 by the Health and Safety Executive. She is co-author of "Reflective Learning: An essential tool for the self-development of health and safety practitioners."