1 Working safely in an engineering environment

Exercise checklist
(Ask your assessor to initial the lower box for each exercise when you have completed it.)

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<tr>
<th>Exercise no.</th>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
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Statutory regulations and organisational requirements

Safety is one of the most important elements in the working life of all people. Mechanical engineers work in an environment which can potentially be very dangerous. Only when dangers are recognised and understood can appropriate measures be taken to protect against personal accidental injury, ill health or damage to equipment. Accidents cost British industry an estimated £4.5 billion each year.

Duties and obligations under the Health and Safety at Work Act, 1974

Over the years, governments have passed safety laws to ensure that both employers and employees observe health and safety measures whilst at work. The most important of these safety laws is the Health and Safety at Work Act, which was made law in Great Britain in 1974. The Health and Safety at Work Act applies to virtually all persons at work in any job. The law places the responsibility for safe working practices onto all of the following parties:

- Employers.
- Persons concerned with premises.
- Persons in control of harmful emissions.
- Designers, manufacturers and suppliers of goods and materials.
- Employees and self-employed.
The details of the Health and Safety at Work Act are long and complicated, but the most important sections are Section 2 (General duties of employers to their employees) and Section 7 (General duties of employees at work). The content of these two important sections is explained below.

### Section 2: General duties of employers to their employees

The Act states that ‘It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees’.

This extends to:

- Providing and maintaining safe plant and systems of work. All machinery and equipment should be in good working order and be safe. Protective clothing and appropriate safety equipment should be made available free of charge for employees to use.
- Arranging the safe use, handling, storage and transport of articles and substances. Included in the transport are all cranes, trolleys and appropriate routes to be used.
- Providing information, instruction, training and supervision to ensure the health and safety of all employees. This includes the provision of safety signs and warnings.
- Maintaining a safe place of work including both access and exit routes. Buildings and workplaces must comply with the safety standards and correct emergency procedures implemented.
- Providing and maintaining safe facilities and arrangements for employees’ welfare at work. For example proper heating, lighting and adequate wash and cloakroom facilities.

In addition to the responsibility of the health and safety of his employees, the employer’s duties under the Act apply to subcontractors, visitors and the general public whose health and safety may be affected by his activities (e.g. harmful emissions to the atmosphere or hazards in a reception area).

There is also a requirement that every employer prepares a written health and safety policy for his employees. This policy should be kept up to date and revised as and when necessary.

A safety representative may be appointed and/or elected from amongst the employees. The representative(s) shall represent the employees in consultation with the employers. The consultation between employers and employees should aim to make and maintain arrangements to promote measures to ensure health and safety at work and to check the effectiveness of these measures.

A Health and Safety Committee should be set up if requested by the safety representatives, to review all measures taken to ensure health and safety at work and to check the effectiveness of the measures.
Section 7: General duties of employees at work

Employees are also bound by the requirements of the Health and Safety at Work Act. The rules relevant to employees state: ‘It shall be the duty of every employee, whilst at work . . .’

- to take reasonable care for the health and safety of himself and others who may be affected by his actions or omissions.
- to co-operate with his employer so far as is necessary, to enable the employer to carry out his duties.

This means that all employees (this is you) must:

- wear suitable protective clothing provided
- use protective equipment and guards provided
- maintain their work area in a tidy manner
- behave sensibly
- apply safe working practices
- be familiar with emergency procedures
- take notice of warning and information signs
- co-operate with supervisors
- report all accidents, dangers and incidents.

Employees must not work on machinery without instruction and supervision, nor should they interfere with or misuse anything provided to protect the health, safety or welfare of themselves or others.

The Health and Safety at Work Act also describes the duties of two bodies, the Health and Safety Commission and the Health and Safety Executive. The Health and Safety Commission assists in the development of health and safety law and promotes health and safety through training, research and publicity. The Health and Safety Executive is concerned with enforcement of the laws. This enforcement is done through inspectors who are employed by local authorities. The inspectors have the power to inspect premises as and when they see fit: any breach of anyone’s duties in health and safety laws may result in an improvement notice or a prohibition notice being served on the premises. In some cases criminal prosecutions follow.

During your training, there must be a person appointed to supervise you and offer you advice and assistance. Throughout this book, this person is referred to as your supervisor. In the event of your supervisor not being available, another person must be delegated to these duties and you should be aware of who this is.

You should also be aware that there is a person appointed to look after safety issues, usually called the Safety Officer. However, for information on safety issues, you would normally refer to your supervisor in the first instance. Your organisation’s Safety Officer or the qualified First Aider can be approached if you need specialist advice and/or assistance about health and safety or first-aid issues.

There may be a company code of practice for additional rules in your workplace. If you follow the company code of practice and heed any warnings, you will significantly reduce your chances of being involved in an accident. Remember: you are required by law to comply with your company’s organisational safety policies and procedures at all times whilst you are at work.
## EXERCISE 1.1

State the name and location of the following persons:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Where based:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your supervisor:</td>
<td></td>
</tr>
<tr>
<td>Your first aider:</td>
<td></td>
</tr>
<tr>
<td>Your safety officer:</td>
<td></td>
</tr>
</tbody>
</table>

Write brief comments of **your** obligations in the following circumstances:

1. You are not sure how to operate a machine required for the task in hand.

2. Your machine guard is broken.

3. You have lost your safety glasses.

4. You need to carry some hot metal parts to a cooling area.

5. The machine you are operating has spilt coolant onto the floor.
6. Your foreman tells you to clean up a mess that someone else made earlier.

7. You see a colleague struggling to carry a large and bulky load.

8. You see some jobs stacked up in front of the fire exit door.

**Witness testimony**

I confirm that ................. has completed the exercise correctly.

Signed. .................. Job title .................................. Date ............

**Sources of information relating to regulations on safety procedures**

Information about health and safety is usually made available to employees by being published on notice boards and posters about the workshops. A health and safety poster must be displayed in places of work to inform employees about the framework of general health and safety duties, safety management and information about safety reps and the responsibilities of the person appointed to deal with health and safety issues. Information about the findings of safety surveys carried out in the workplace would normally be made available to employees through their safety representatives or information on notice boards.

**Complying with statutory regulations**

The Health and Safety at Work Act 1974 covers virtually everyone in all kinds of work. There is also legislation relating to specialist engineering processes or situations. If you require safety information about a specific task, it may be useful to refer to one or more of the following acts or regulations:

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- Abrasive Wheel Regulations 1970.
- Eye Shield Regulations 1974.
- Health and Safety (First Aid) Regulations 1981.
- Electricity at Work Regulations 1989.

The above list is far from complete as there are many more laws related to health and safety not listed here.

<table>
<thead>
<tr>
<th>EXERCISE 1.2</th>
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</thead>
<tbody>
<tr>
<td>State six health and safety requirements in your work area which you must obey:</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>5.</td>
</tr>
</tbody>
</table>

State four health and safety requirements in work areas that you regularly pass through which you must obey:

| 1. | 2. |
| 3. | 4. |

Witness testimony

I confirm that ........................................ has completed the above exercises correctly.

Signed ......................... Job title ........................................ Date .............
Warning signs and labels of the groups of dangerous substances

The warning signs below are designed in accordance with the classification, packaging and labelling of dangerous substances regulations. The square orange box with a black symbol is attached to labels and packaging: it gives information about any hazards related to the contents. The signs are used to mark the main groups of hazardous substances.

<table>
<thead>
<tr>
<th>Sign:</th>
<th>Example:</th>
<th>Precautions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly flammable</td>
<td>Petrol.</td>
<td>No smoking or naked flames.</td>
</tr>
<tr>
<td>Explosive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poison or toxic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxidising</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmful/ Irritant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Follow accident and emergency procedures

Under the Health and Safety (First Aid) Regulations, workplaces must have first-aid provision. In general, this includes a person who is trained as a First Aider, and there must also be at least one adequately stocked first-aid box that is clearly labelled. Note that first-aid boxes are primarily for the use of the registered First Aiders. Most large companies and colleges have a first-aid treatment room.

You should know who the First Aider is and where he/she can be found in an emergency. You should also know the location of the first-aid facilities.

In the event of an accident, always get the First Aider to the scene of the incident as soon as possible. Where possible stay with the casualty and send someone to get the First Aider. If for any reason the First Aider is not available, dial 999 and ask for an ambulance.

However, it is important to know what to do in the event of the First Aider not being immediately available and certainly in the case of electrocution.
If someone gets an electric shock, you should take the actions listed below but on no account should you risk becoming electrocuted.

- Switch off the electric current. **Do not touch the casualty until you have done this.** Get to know where the mains switch is.
- Send for the First Aider immediately: if you become involved the First Aider will save you too.
- Start artificial respiration if the casualty is not breathing (see below).
- Continue until further medical aid arrives.
- Reassure the casualty that help is on its way.

Allow the casualty to rest and keep them under observation.

Note: If the current cannot be switched off, free the casualty from the electrical source with insulating gloves or with some dry, non-conducting material (e.g. a wooden stick or a wooden chair).

The casualty might be:

- Not breathing.
- In a state of shock.
- Suffering other injuries.
- Burnt.
- At risk of collapsing later in the day.

If someone gets a deep cut, the procedure would be to take the following actions:

- Send for the First Aider.
- Wash the cut area with flowing clean cold water.
- Hold the injury up high.
- Wrap or bandage firmly.
- Position the casualty in a comfortable position until further medical help arrives.
- Reassure the casualty that help is on its way.

If someone gets a chemical burn, the procedure would be to take the following actions:

- Send for the First Aider.
- Remove any contaminated clothing which is not stuck to the skin.
- Rinse the area thoroughly with flowing clean cold water for 10 to 15 minutes.
- Keep the affected area clean.
- Reassure the casualty that help is on its way.

If someone gets a heat burn, the procedure would be to take the following actions:

- Send for the First Aider.
- Rinse the area with flowing clean cold water for 10 minutes (or until the First Aider arrives).
- Keep the burn area as still as possible.
- Reassure the casualty that help is on its way.
- **Never** touch the affected area.
- **Never** apply ointments to the affected area.
- **Never** remove clothing.
If you suspect that someone has a **broken bone**, the procedure would be to take the following actions:

- Send for the First Aider.
- Do **not** move the casualty unless he is in a position that exposes him to further danger.
- Keep the casualty warm.
- Reassure the casualty that help is on its way.

### Artificial respiration procedure

If a casualty was found not to be breathing following an accident, or after breathing fumes or smoke caused by fire the action to take would be as follows:

- Send for expert help.
- Remove obstructions from casualty’s airway.
- Raise the nape of the casualty’s neck and press his forehead back (to straighten the airway).
- Pinch the casualty’s nose and seal your lips round his opened mouth.
- Blow firmly into the casualty’s mouth until his chest rises.
- Allow the casualty’s chest to fall.

Continue the process about 12 times per minute (every 5 seconds) until expert help arrives.

### Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)

Following an accident a formal accident report must be made in the company’s accident book. You should make sure that you are aware of the accident reporting and recording procedure for your workplace.

Dangerous occurrences that happen at work should also be formally reported. The report should be maintained in a book, a written log or a computer record. This enables measures to be taken to lessen the chances of similar accidents happening again. RIDDOR Regulations
define what constitutes a major injury; a dangerous occurrence and a reportable disease.
Some possible examples for engineering situations are listed below:

**Major injury**
- Fractured bones (other than fingers, thumbs and toes).
- Dislocation of shoulder, hip, knee or spine.
- Loss of sight or an eye injury.
- Unconsciousness due to electric shock.
- Any injury requiring admittance to hospital for more than 24 hours.

**Dangerous occurrences**
- Collapse, overturning or failure of load-bearing parts of lifts or load-bearing equipment.
- Explosion, collapse or bursting of any closed vessel or pipework.
- Failure of any freight container in any of its load-bearing parts.
- Plant or equipment coming into contact with overhead power lines.
- Electrical short circuit or overload caused by fire or explosion.
- Any unintentional explosion.
- Any accidental release of a biological agent likely to cause severe human illness.
- Stop buttons or clutches not working properly.
- Collapse of scaffold over 5 metres high.

**Reportable diseases**
- Certain poisoning.
- Skin diseases including dermatitis, skin cancer.
- Lung diseases, occupational asthma, asbestosis.
- Infections such as hepatitis, anthrax, tetanus.
- Other conditions such as occupational cancer and hand-arm vibration syndrome.

**EXERCISE 1.4**
State the procedure you must follow in case of an accident to another person in your workplace.

Fill in the spaces below.

| Name of the nearest qualified First Aider | Tel. no. |
Name of another qualified First Aider  |  Tel. no.  
---|---
Location of first-aid box  |  Nearest supply of clean water  
Location of first-aid room  |  Person you must inform following an accident  
Location of accident book  
Ask the First Aider for access to the first-aid box in your work area, and write its contents here:
The first-aid box in my work area contains the items listed below:
1. 4. 7.
2. 5. 8.
3. 6. 9.

Witness testimony

I confirm that I.............................. has completed the above exercise correctly and that the trainee knows the symptoms of an electric shock, the actions to be taken before touching suspected electrocution victims and the basic resuscitation procedure.
The trainee has answered questions on the meaning of dangerous and hazardous malfunctions, and knows why these need to be reported, even if no injury occurred.

Signed ..........................  Job title ..........................  Date ................

**Procedures for emergency situations and evacuation of premises**

Fires can have devastating effects on industrial and domestic premises. In 1997, UK fire brigades attended 36,000 fires in workplaces, these fires killing 30 people and injured over 2600 others. After a serious fire, many firms never trade again. Fire strikes in a variety of ways and we all must be aware of how to avoid danger to ourselves and our work-mates in the event of a fire. **Fires cost lives and jobs.**

Premises can be inspected by fire officers who would award a fire safety certificate if the inspection was satisfactory.

For an outbreak of fire there must be the following three elements present:
- **Fuel** – some material that burns.
- **Heat** – the temperature at which fuels ignite (the flash point) varies from one fuel to another.
- **Oxygen** – present in the air.
If fuel, heat and oxygen are all present a fire could develop. Some common causes of fire in industrial premises are:

- Electrical faults.
- Discarded cigarette ends.
- Gas and electric welding.

Common fire precaution measures are:

- No smoking areas.
- General tidiness.
- Appropriate siting of litter bins and ash trays.

The systems below reduce the spread of fire and enable fires to be tackled before getting out of control.

- Fire alarm system.
- Fire doors.
- Fire extinguishers.
- Water sprinklers.
- Emergency exits.

The emergency evacuation procedure is not only for fires, it operates for many emergency situations. The procedure should be familiar to all personnel in the building and must be supported by information notices (in general you should close all doors and windows then leave the building by the shortest route, avoiding any flammable materials storage, assembling at a point where you will be registered as safely out of the building). There may also be maps showing the location of assembly points and how to get to them. Ideally the fire procedure should be practised at regular intervals. Get to know where the fire alarm buttons are sited, and remember what the evacuation alarm sounds like.

Use of basic fire fighting equipment

If a fire is tackled when it is small there is less chance of it getting out of control. You can tackle a small fire with a portable fire extinguisher. Care must be taken to select and use the appropriate type of extinguisher for the type of fire, as it can be dangerous to use an inappropriate appliance, particularly if there is an electrical supply in the fire. When fighting a fire always ensure your escape route is clear. Fire extinguishers work by either preventing the oxygen from reaching the flames or by removing the heat from the fuel; some types of fire extinguishers work in both ways. The most common types of fire extinguishers only last for about 20–45 seconds so they must be used efficiently and with care for best results. Shown below are the most common types of extinguisher, together with the types of fire for which they are most effective.

Note. BS Guidelines now recommend all new fire extinguishers are painted red (older appliances were colour coded according to their contents).
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Water
(formerly red)
Used on solid fuelled fires – NOT electrical apparatus.

Foam
(formerly cream)
Used on liquid and solid fuelled fires.

Dry powder
(formerly blue)
Used on liquid, solid and electrically fuelled fires.

Carbon dioxide
(CO₂) Gas
(formerly black)
Used on liquid and electrically fuelled fires.

EXERCISE 1.5
Write here the procedure you should follow if a fire breaks out in your workplace (number 1 is completed for guidance).

1. Sound the fire alarm to alert others to the danger.

2. 

3. 

4. 

5. 

Common fire precaution measures are listed below. For each one, find an example in your work area and write its location in the space provided.

1. Fire doors

2. Fire alarm system

3. Emergency exits

4. Fire extinguishers

5. Water sprinklers
In the space, draw a map of the route you must follow if you hear the emergency alarm in your work area.

State what you should do when you reach the Fire Assembly point.

State when you are authorised to leave the Fire Assembly point.

In a practice Fire Drill it takes me .................. (time) to get to the fire assembly point.

Examine two different types of fire extinguisher and copy the operating instructions into the space below.

<table>
<thead>
<tr>
<th>Type:</th>
<th>Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions:</td>
<td>Instructions:</td>
</tr>
</tbody>
</table>
Witness testimony

I confirm that .............................................. has completed the above exercise correctly and that the trainee knows his/her lines of reporting and limits of his/her responsibilities in emergency situations.

The trainee is aware of things s/he can do to prevent fires developing and spreading.

Signed.................................. Job title ................................................. Date ..............

Dressing prepared for work activities

Those who work on or near moving machinery should not wear lose or torn clothing – it could become entangled in moving parts and cause serious accident. Always remove ties, rings, neck chains and other jewellery and only wear clothing that fits correctly.

Personal protective equipment (PPE) must be issued to – and used by – engineers when tasks can not reasonably be made safe in other ways. Common types of PPE include the following:

**Overalls**

Overalls are necessary when there are moving parts of machinery and the engineer needs to keep his loose clothing contained to prevent entanglement. Overalls also provide a means of keeping dirt and chemicals off engineer’s clothes. As well as these safety uses, overalls can also provide identification and security when used as a type of uniform.

Various styles of overall are in common use.

**Safety boots**

A pair of safety boots made to BS 1870 will have many safety features. The most noticeable feature is steel toecaps. These can protect the toes should a heavy object be dropped onto the foot. Other safety features found on some industrial footwear are listed below.

A. Steel toecap: toe protection against falling objects.
B. Chemical/oil resistant soles: for grip in oily and chemical environments.
C. Non-slip rubber sole: tread pattern improves grip on smooth surfaces.
D. Steel inner sole: Protects against penetration from underneath.
E. Ankle protection: helps to avoid injury to achilles tendon.

**Safety glasses**

Various types and styles are available. BS 2092 lenses are suitable for protection against impact from flying debris in an engineering workshop. Safety glasses are to be worn at all times in workshops, whether you are operating a machine or not.
Safety helmet (hard hat)

Wear a safety helmet when working:
- below others in case they drop something
- in places where the ceiling is low or uneven
- when a sign directs you to do so.

Hats

Hats should be worn by all when there is any risk of getting your hair tangled in a rotating tool or workpiece. The picture shows what can happen if you get the top of your head too close to a rotating drill in a drilling machine.

Ear defenders and earplugs

Necessary for those working in areas where loud noise levels (80 decibels) exist. Ear defenders look like headphones, earplugs are smaller and fit inside the ears.

Gloves

Gloves are worn for hand protection. The main types in common use are listed below.

**Leather**. Leather gloves are tough and flexible, and should be used when handling things that have sharp edges to protect hands against being cut.

**Thermal insulation**. Gloves offering thermal insulation are made of leather and lined with an insulation material. Asbestos was used for this insulation years ago, and is now known to be a very dangerous material, but these gloves are still sometimes wrongly called 'asbestos gloves'.

**Rubber** (Latex). Thin rubber (latex) gloves provide protection against the effects of a wide range of chemicals, e.g. salts, detergents and harmful oils. Never use these gloves unless you are sure they will protect you against the chemical you are exposed to.
**Apron**

Rubber or polypropylene clothing provides protection against the effects of chemicals. Never use this equipment unless you are sure it will provide protection against the particular chemical you are exposed to.

**Dust mask**

Dust masks should be used when working in a dusty environment. If the air in a work area can not safely be filtered by fume and extraction equipment, an engineer should wear a dust mask to filter the air for his own protection. Remember that the filter only removes dust particles and not poisonous gases.

**Respirator**

If the air in a work area can not safely be extracted and filtered by fume and extraction equipment, then a respirator is needed. Respirators are facemasks which draw a clean supply of air from elsewhere (note the air supply pipe in the drawing). Respirators must be worn when working in poison environments or where fumes and chemicals may leak, causing discomfort or illness.

**Other specialist protection**

There are other pieces of specialist protective clothing available for those working in hazardous environments. The items of protective equipment described above are the most common, but if you are at all concerned about working in an environment, always ask your supervisor or another responsible person about protective clothing.

**Personal hygiene procedures**

Wash your hands at the end of each work shift and before eating or handling food. This is very important because many products in the workshop, particularly lubricants and oils, are harmful and if consumed can cause illness. Food should never be brought into an engineering workshop.

Clean your overalls regularly to reduce the chances of contaminants or irritants like oils soaking through the material and becoming in constant contact with your skin. Oil on your skin can cause a skin disease called dermatitis. Dermatitis particularly affects sensitive skin so always wash your hands before using the toilet. You can minimise the chances of getting dermatitis on your hands by applying protective barrier hand cream; this hand cream should always be applied at the start of every work session.
**EXERCISE 1.6**

In each of the following three sections, complete the blank spaces as instructed:

1. **Protective clothing**
   In the drawing of an engineering trainee, it can be seen that he is dressed in a potentially dangerous way. List nine points that are a potential hazard to his safety.

   a) His long hair is not contained
   b) 
   c) 
   d) 
   e) 
   f) 
   g) 
   h) 
   i) 

2. **Safety footwear**
   Industrial footwear has built-in safety features. Write in each space a short note to indicate the circumstances when the specified safety feature is required.

   a) Non-slip rubber sole
   b) Chemical resistant soles.
   c) Steel inner inside the sole.
   d) Ankle protection
   e) Oil resistant soles
   f) Quick release laces

3. **Work environment**
   Briefly explain the work environment that would require the following safety clothing and equipment, and state why they are necessary. The first one has been completed for your guidance:

   a) Overalls
   Necessary when loose clothing needs to be contained to prevent entanglement with moving parts of machinery.
   b) Rubber gloves
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c) Leather gloves  
d) Barrier cream

e) Safety glasses  
f) Helmet

g) Safety boots  
h) Ear protectors

i) Aprons  
j) Hats

Witness testimony

I confirm that......................... has completed the above exercise correctly, that the trainee has been observed by me continuously to be wearing appropriate personal protective equipment and suitable clothing for his/her work activities and that the candidate knows what protective clothing is available in his/her work area.

Signed .................  Job title .................................................. Date ............

Behaviour in the working environment

Your behaviour in an engineering workshop must be responsible and appropriate. This means that you must always follow these rules:

- Wear safety glasses at all times in the workshop.
- Use protective clothing and equipment.
- Know the emergency stop procedures.
- Follow instructions carefully.
- Be aware of what is going on around you.
- Use appropriate guards on all machine tools.
- Use correct lifting technique.
- Observe all signs in work areas: they are there for your benefit.
- Observe all company rules and restricted area notices.
- Ask for help and advice when unsure about anything.
- Follow all the rules laid down by your employer.

You must never:

- run in the workshop
- smoke in unauthorised areas
- operate a machine without authorisation
- start a machine unless you have been shown how to work it properly
- throw anything
- push persons or get involved in horseplay
- remove a guard from a machine
Working safely in an engineering environment

- distract others operating a machine by asking questions, shouting or making loud noises
- play around with compressed air lines.

It is important to develop safety awareness and be alert at all times.

EXERCISE 1.7

Give three reasons why it is always necessary to behave responsibly in an engineering workshop in order to conform to the Health and Safety at Work Act 1974.

1. 

2. 

3. 

State where your organisation’s health and safety policy is kept and who is responsible for reviewing and updating it.

Kept in: Reviewed and updated by:

Witness testimony

I certify that ............................................ has been observed by me to be continuously behaving in a safe and orderly manner and observing the establishment’s health and safety policies.

Signed: ............................................ Job title: ............................................ Date: ............

Manual handling techniques

Stretching, reaching over and lifting are some of the most hazardous things you do at work. 40% of all sick days off work are due to ‘handling injuries’. 54 million days are lost each year because of back problems. It is therefore particularly important to learn how to manually lift and move articles safely. You may need to use manual handling techniques if powered lifting aids (jacks, hoists and cranes) are not available and the load to be moved is within your capability.
Once you know how to lift safely, it is important to get into the habit of doing so to prevent any injury occurring.

The human spine is made up of a column of cylindrical bones called the vertebrae. The column is held together by strong ligaments, and each disc separates a vertebra. The disc material is flexible so that movement is possible and it also allows shocks to be absorbed. If the spine is strained while lifting or carrying, the ligaments can be damaged or the discs may be displaced. Either of these injuries result in acute pain. For the back to be at its strongest, the spine should be vertical. Hence, when lifting heavy or awkward loads, you should bend at the knees and keep your head up rather than bend the back.

As a guide, do not attempt to lift more than 20 kg without assistance. Always ask for help with bulky or awkward loads and ensure that any load that is being transported does not obstruct your vision. If assistance is not available, use powered lifting equipment. Remember it is good practice to clear the area you are going to put the load on before it is picked up.

**Transporting loads with manual trolleys and hand carts**

Trucks are frequently used for transporting heavy or bulky articles over smooth surfaces. A large variety of trolleys, trucks and carts are sold for use in factories. Some are shown below. When using them you should maintain the speed at a minimal level, taking particular care with corners and down hills. The truck should be loaded with the biggest part of the weight low down and away from the edge. Special training and licences are necessary before you can use a powered forklift truck: their use is not covered in this book. You should neither stand nor stack articles near routes used by forklift trucks.
Housekeeping in the work area

A tidy workshop is more likely to be a safe workshop. Always keep a lookout for mislaid things that people could trip over or slip on and tidy them up – this is your duty under the Health and Safety at Work Act. Spilt oil can be cleared up with a mop and then covered with sawdust. Gangways and exit routes in particular should be clear of obstacles at all times.

Care when storing and stacking materials is essential or accidents can happen if the stack of materials is lightly knocked. If things are left sticking out of shelves, people passing by could be affected.

Take care while laying electric power cords so that they do not become ‘trip wires’: it is correct to position a sign to inform others of such hazards and use a protective cover over the flexible cable.

Apart from safety, general workshop tidiness is important because it makes it easy to find equipment.

Storage of tools, equipment and materials

Engineering tools and equipment should always be used correctly to minimise accidents and to keep them in good working order. Engineering tools refer to hand tools, measuring tools and powered hand tools. Equipment includes all types of equipment used in the workshop from vices and benches to lifting tackle. Materials should be stored and transported carefully and in such a way as to minimise the risk of injury.

General rules for safe use of tools and equipment

- Carefully select the correct tool for the job.
- Never use any tools/equipment without full instruction or training. If you are not sure, ask your supervisor.
- Check tools/equipment for any obvious faults, damage or excessive wear before use. Never use a faulty tool or equipment: report it to your supervisor.
• Always follow set safety rules and procedures, e.g. files must be fitted with handles, guards used on machine tools, protective clothing worn when necessary.
• For powered hand tools, use 110-volt equipment with a transformer whenever possible: the lower voltage significantly reduces the severity of electric shocks.
• Know the emergency stop procedures for all powered tools and machines.
• Take care to lay power tool cords avoiding ‘trip wires’.
• Switch off the electrical supply after working electrical hand tools.
• Never operate electrically powered hand tools with wet hands, near water or flammable liquids.
• Treat all tools/equipment with respect and never use any tools or operate machinery if you are unwell or unfit to do so.

**General rules for storage of tools and equipment**

• All tools and equipment must be stored in a way that does not present a risk of injury to persons, e.g. sharp edges should be covered, long items should not protrude from shelves.
• After use, tools and equipment should be cleaned as instructed.
• Tools and equipment should be tidily stored in a clean and dry place.
• Tools and equipment should be stored in their specially allocated place to enable easy retrieval. If issued by the storeman, they should be returned to him.
• Accurate measuring tools may be lightly oiled before being stored to prevent corrosion.

**General rules for handling and storage of materials**

• Always use correct lifting techniques.
• Wear appropriate protective clothing to guard against possible injury.
• Store materials away from gangways.
• Flammable materials should be kept away from naked flames.
• Liquids should be moved only in sealed containers to avoid splashing.
• Gas cylinders must be in well-ventilated areas and away from risk of impact.
• Hot materials should be cooled in protected areas.
• Observe and obey any special instructions or safety signs.

**EXERCISE 1.8**

Give three reasons why it is always necessary to maintain the work area, exits and gangways in a clean and tidy condition to conform to the Health and Safety at Work Act 1974.

1. 

2. 
3.

Witness testimony

I certify that ........................................ has been observed by me to be continuously maintaining a safe and tidy work area and that he/she has been questioned and found to be aware of the importance of safe storage of tools, equipment, materials and products.

Signed ........................................ Job title ............................................... Date ............... 

Disposal of waste materials

Environmental concerns are ever more important in life today. All companies have two outputs: one that everyone wants – the product – and the other that no one wants – the waste materials. Most waste materials are a hazard in the workplace: they can be in the way, they might cause fire risk and use up valuable storage space. Metal swarf and off cuts have dangerous sharp edges. Always remove your waste before it gets in your way and take it to the correct collection point. While disposing of chemicals (e.g. oil or coolant) make sure you follow the guidelines set out in the manufacturer’s COSHH leaflet. Local authority sites are for domestic household products only, and industrial waste must be disposed of separately and safely. Usually most companies use contractors to deal with their industrial waste. The contract companies may recycle the waste. If you are unsure about how to dispose of any waste material you must seek advice.

Never mix chemicals together or put them into drains: this could be environmentally disastrous and your company will be charged under the rules of the Health and Safety at Work Act.

EXERCISE 1.9

Demonstrate to your assessor the correct technique for manually lifting a heavy load. Identify to him the alternative means of lifting or moving a load that are available to you if the load is too heavy or bulky for you to handle alone.

<table>
<thead>
<tr>
<th>Heavy load</th>
<th>Load moved:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainee to demonstrate knowledge and ability to safely relocate a heavy load and suggested sensible alternative of moving load.</td>
<td>From:</td>
</tr>
<tr>
<td></td>
<td>To:</td>
</tr>
<tr>
<td></td>
<td>Alternative:</td>
</tr>
</tbody>
</table>
Control of hazards in the workplace

Witness testimony
I have observed ......................... move the above load in a correct and safe manner using recommended lifting techniques.

Signed ......................... Date .........

2. Bulky load
Trainees to demonstrate knowledge and ability to safely relocate a large bulky load and suggested sensible alternative of moving load.

Load moved:
From:
To:
Alternative:

Witness testimony
I have observed ......................... moving the above load in a correct and safe manner using recommended lifting techniques.

Signed ......................... Date .........

Hazard spotting
A hazard is something with the potential to cause harm. Hazards may be associated with the following:

- contaminants/irritants
- dust/fumes
- electricity
- fire
- materials handling
- material transporting
- moving parts
- pressure storage
- slippery surfaces
- tools
- toxic/volatile materials
- uneven surfaces
- unshielded processes
- working at height.

Hazard control measures
If you see a hazard, it should be eliminated, removed or isolated. Stop working when you become aware of a hazard and try to control it. The use of PPE is a last resort for hazard avoidance, so you should fit guards, use fume-extraction equipment or limit access to unauthorised personnel whenever possible.
Risk

A risk is the likelihood that a hazard will cause harm. A risk can depend on a number of different factors, e.g. the risk of a person slipping on a wet floor depends on:

- the amount of water on the floor
- the smoothness of the floor’s surface
- the types of shoe sole the people have
- the number of people walking over the area
- the size of the area covered in water.

Risk assessment

Risk assessment is a method of identifying the severity of risk in the workplace. Risk assessments must be carried out by employers by law. They help to eliminate accidents and the associated cost of accidents. Risk assessments highlight training needs and help prioritise the implementation of health and safety measures.

One method of conducting a risk assessment is as follows:

- Identify and list all the hazards you can find.
- Identify who is at risk. This could be persons from the following work categories:

<table>
<thead>
<tr>
<th>Office staff</th>
<th>Visitors</th>
<th>Disabled staff</th>
<th>Members of public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaners</td>
<td>Operators</td>
<td>Site workers</td>
<td>Maintenance personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>etc.</td>
</tr>
</tbody>
</table>

- Assess the likelihood of an accident happening due to the identified hazard (you can use a scale of 1–5 as shown).

  Scale: 1 = Very unlikely to happen, causing harm  
         2 = Unlikely to happen, causing harm  
         3 = Possible to happen, causing harm  
         4 = Likely to happen, causing harm  
         5 = Very likely to happen, causing harm

- Evaluate the severity of a possible injury (you can use the scale of 1–5 as shown).

  Scale: 1 = Minor injury  
         2 = Major injury  
         3 = Loss of limb  
         4 = Death of an individual  
         5 = Multiple deaths

- Evaluate the risk by multiplying the two ratings together:

  \[ \text{Risk} = \text{Likelihood rating} \times \text{Severity rating} \]

Following the risk-assessment process, you should

- consider situations with the highest risk ‘scores’ and take measures to reduce the risk by any appropriate means
- record all your findings on a risk-assessment document (see Appendix XIV)
- ensure risk assessments are reviewed regularly and revised if/when necessary.
Examples of risk assessment

Example 1. A slippery floor in a motorway service station would be rated as follows:

Hazard: a wet floor in a motorway service area
Who is at risk: members of public
Likelihood of accident: 4 (likely to happen, causing harm)
Severity of accident: 2 (possible major injury)
Risk assessment result = Likelihood rating × Severity rating = (4 × 2) = 8 (out of a worst possible score of 25).

Actions:
- Put up warning sign
- Mop and dry floor
- Return frequently to see if floor is dry
- Remove sign when hazard has gone.

Review notes: floor should be inspected to see if it is dry every 20 mins.

Example 2. On a building site at the service station, bricks are stored near the edge of scaffolding platforms.

Hazard: storing bricks near the edge of scaffolding platforms
Who is at risk: site workers
Likelihood of accident: 3 (possible to happen, causing harm)
Severity of accident: 4 (possible death of an individual)
Risk assessment result = Likelihood rating × Severity rating = (3 × 4) = 12 (out of a worst possible score of 25).

Actions:
- Cordon off area below scaffolding
- Put up protective ‘toe board’ to restrict chances of bricks falling
- Issue workers with hard hats
- Put sign up to warn of danger
- Put sign up to make hard hat mandatory
- Limit access to the high-risk area to allow access only to those needing to work in that area.

Review notes: this must be corrected by 7:45 a.m. tomorrow.

In the two cases above, there is a greater risk caused by the brick on the scaffolding than the slippery floor, so the risk associated with the brick must be addressed as priority issue.

EXERCISE 1.10

Part 1
Carry out simple hazard-identification inspection on both:
a) your immediate work area
b) work areas that you pass through.

Write your findings in the appropriate boxes below:
### Part 2

Conduct **three** risk assessments by identifying different hazards and ‘severity-of-accident’ levels. Use copies of Appendix XIV for this part of the exercise.

Use at least **three** of the following five categories:

- a) your working environment
- b) tools and equipment that you use
- c) materials and substances that you use
- d) working practices
- e) accidental breakages and spillages.

Assess the relative risks and insert suitable actions that may need to be taken.

<table>
<thead>
<tr>
<th>Risk assessment ‘title’</th>
<th>Number 1</th>
<th>Number 2</th>
<th>Number 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category (a–e) above</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Who should be informed on actions to be taken to deal with risks in the workplace that you are unable to deal with?**

**Name of person**

**State your** organisation’s procedures for controlling risks to health and safety in the space below:
Witness testimony

I confirm that ......................... asked me about the health and safety issues outlined by him/her above and that the trainee knows what constitutes a hazard and his/her responsibilities for dealing with hazards and rectifying risks in the workplace.

Signed ...................... Job title ........................................... Date ..........

Safety rules, signs and warnings

Employers put up various signs in order to ensure that employees are aware of the dangers in work areas and of the precautions necessary to reduce risk. The five categories of sign described below are the recommended shape and colour to meet with the safety signs at work regulations.

<table>
<thead>
<tr>
<th>Mandatory (compulsory)</th>
<th>Prohibition (forbidden)</th>
<th>Danger warning</th>
<th>Safe condition</th>
<th>Fire equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety boots must be worn</td>
<td>Do not drink this water</td>
<td>High voltages</td>
<td>Emergency escape route</td>
<td>Fire-extinguisher point</td>
</tr>
</tbody>
</table>

Control measures to minimise risks

Guards

The purpose of a guard is to protect. Guards may be designed to protect people, fragile workpieces or machine parts. There are many types of guard used in engineering today. Some of the purposes of guards are listed below. It must also be noted that guards have many methods of operation. Most guards are mechanical barriers and may be transparent. Some guards are electrical and operate either as ‘magic eyes’ to switch off a machine if an invisible beam is broken or as interlocks to prevent a machine from working until it is safe.

Guards may be used to:

- protect operators and other persons, who may be passing, from getting into contact with moving parts
- prevent swarf and other particles flying out of machines and causing injuries
- prevent objects coming into contact with items of machinery, which may be delicate or fragile
- prevent unauthorised persons working machines
- keep people or their limbs out of danger areas
- prevent a machine damaging itself.
EXERCISE 1.11
Write in the spaces below two situations when you took action to ensure the working environment was made safer.

1. 

2. 

Witness testimony
I certify that ........................................ was observed by me to have taken the action s/he has outlined above and that s/he knows what measures can be taken to minimise risks.

Signed ........................................ Job title ............................................................ Date .............

Accident-reporting procedure
If you take care, then this significantly reduces the chances of you being involved in an accident. There is always the chance that a system could fail or another person could disregard safety rules, causing an accident to happen.

Should this happen, you need to know who to inform, how to report an accident in your workplace and where the accident book is kept.

EXERCISE 1.12
State the name of two reliable persons you can refer to on health and safety issues:

<table>
<thead>
<tr>
<th>Name of person 1:</th>
<th>Where based:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of person 2:</th>
<th>Where based:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

State an instance when you sought information about a health and safety issue from either of the above named persons. Describe the issue and the recommended solution.
EXERCISE 1.13

(Application of Number – Assignment 1. This exercise is specifically included to enable key skills requirements to be fulfilled.)

Task 1
Look at the following accident statistics taken from a Health and Safety Executive source.

<table>
<thead>
<tr>
<th></th>
<th>Construction</th>
<th>Creamery</th>
<th>Transport</th>
<th>Oil platform</th>
<th>Hospital</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks on site</td>
<td>18</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>NA</td>
</tr>
<tr>
<td>Number working on site</td>
<td>120</td>
<td>338</td>
<td>80</td>
<td>210</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Over 3-days lost time injuries</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Minor injuries</td>
<td>56</td>
<td>31</td>
<td>0</td>
<td>8</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Non-injury accidents</td>
<td>3570</td>
<td>889</td>
<td>296</td>
<td>252</td>
<td>1168</td>
<td></td>
</tr>
<tr>
<td>Total accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Statistics adapted from The Costs of Accidents at Work – HSE pub.)

(a) Fill in the blank spaces on the table by adding up the rows and columns.

(b) Complete the following table by calculating the number of accidents per employee. (Answers to the nearest whole number.)

<table>
<thead>
<tr>
<th></th>
<th>Construction</th>
<th>Creamery</th>
<th>Transport</th>
<th>Oil platform</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number on site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of injuries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(c) Complete the following table by calculating the number of accidents per week.

<table>
<thead>
<tr>
<th>Number of accidents per employee</th>
<th>Construction</th>
<th>Creamery</th>
<th>Transport</th>
<th>Oil platform</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time during which accidents could occur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of non-injury accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of non-injury accidents per week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(d) Display the number of accidents per week for the range of industries in a form other than in a table and explain why you have chosen that format.

(e) Note that the majority of accidents did not result in anyone being injured. Calculate the ratio of non-injury accidents to injury accidents and fill in the table with your results.

<table>
<thead>
<tr>
<th>Total number of accidents resulting in an injury</th>
<th>Construction</th>
<th>Creamery</th>
<th>Transport</th>
<th>Oil platform</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Non-injury accidents

Ratio of injury accidents to non-injury accidents

Express answers in their simplest form and in whole numbers

(f) Which of the above industries has the worst accident record?

Task 2
To prevent accidents due to people slipping, most engineering workshop floors are coated with a non-slip surface.

During the summer shut-down period, a machine shop measuring 30 m long × 20 m wide will have the floor recoated. Look at the following diagram:
Note there are 15 machines: six lathes, occupying a floor space of $1 \times 2$ m each, and nine milling machines, each of which is $1 \times 1.5$ m wide. The gangways are 1 m wide – one goes from one end of the workshop to the other and the other two gangways span the workshop. All the gangways are to be painted grey. The remainder of the floor is to be painted green.

It is essential that you show the stages in your working for the following calculations.

(a) Calculate the total area to be painted grey.

(b) Calculate the total area to be painted green.

1 litre of paint covers 10 m$^2$ and it can be bought as follows:

<table>
<thead>
<tr>
<th>Size of tin in litres</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>£8.50</td>
</tr>
<tr>
<td>2.5</td>
<td>£20.00</td>
</tr>
<tr>
<td>5</td>
<td>£38.50</td>
</tr>
<tr>
<td>10</td>
<td>£75.00</td>
</tr>
</tbody>
</table>

Note that orders over £500 receive a 12% discount on the total order.

(c) Calculate the volumes of green and grey paint needed and then work out the most economical way in which it can be purchased. Calculate the final price for the paint.

The final price for the paint will be:

(d) Convert the following from metric units to imperial (see overleaf for conversion units):

<table>
<thead>
<tr>
<th>Required unit</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of workshop</td>
<td>Feet</td>
</tr>
<tr>
<td>Width of a milling machine</td>
<td>Inches</td>
</tr>
<tr>
<td>Area to be painted grey</td>
<td>Square yards</td>
</tr>
<tr>
<td>12 litres</td>
<td>Pints</td>
</tr>
</tbody>
</table>
Approximate conversion factors:

1 m = 39 inches
1 m² = 1.17 square yards
1 litre = 1.75 pints

(e) Indicate how you have checked to make sure that your results both for the areas and for the volumes of paint needed make sense.

Task 3
In many engineering firms, heavy equipment and stores need to be moved. A small forklift stacking truck may be used for this purpose.

The truck in the stores has a clear notice that states that the maximum load is 500 kg. Look at the following information, which relates to density and dimensions of the material, and show whether they can be safely lifted by the stacking truck. Complete the table with your results.

Density = \[
\frac{\text{Mass}}{\text{Volume}}
\]

<table>
<thead>
<tr>
<th>Metal density (kg/m³)</th>
<th>Dimensions</th>
<th>Volume (m³)</th>
<th>Mass (kg)</th>
<th>Safe to lift?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium 2720</td>
<td>0.5 m x 0.5 m x 0.5 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brass 8480</td>
<td>0.5 m x 0.5 m x 0.2 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast iron 7200</td>
<td>1 m x 0.5 m x 0.2 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper 8790</td>
<td>2 m x 0.25 m x 0.2 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel 7820</td>
<td>1.5 m x 0.45 m x 0.01 m</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Show your calculations here:

The above exercise was completed satisfactorily by ............................., who could also explain how work had been checked to ensure that results made sense.

Signed ............................ Job title ................................. Date ............