BRITISH STANDARD

Health and safety for design and technology in schools and similar establishments – Code of practice

ICS 03.180; 13.110

British Standards

Publishing and copyright information

ISBN 978 0 580 50452 5

The following BSI references relate to the work on this standard:
Committee reference GME/27
Draft for comment 06/30138306 DC

Publication history

First published February 1968
Second edition, April 1975
Third edition, June 1984
Fourth edition, July 2000
Fifth edition, May 2007

Amendments issued since publication

Amd. no.	Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to viii, pages 1 to 131 and a back cover.

This page deliberately left blank

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 May 2007. It was prepared by Technical Committee GME/27, *Safety in school workshops*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 4163:2000, which is withdrawn.

Information about this document

The Health and Safety at Work etc. Act 1974 places a general duty on employers to ensure, as far as reasonably practicable, the health and safety of employees and other persons affected by their activities. The Management of Health and Safety at Work Regulations 1999 require employers to carry out risk assessments for the purpose of identifying what should be done to comply with this general duty and any relevant Regulations made under this Act. This code of practice is primarily for protection of students, employees, trainee teachers, and other adults across the full range of design and technology teaching areas. Implementation of this code of practice is not a legal requirement but it does provide one means of demonstrating that reasonably practicable steps have been taken to minimize risks from the machinery, equipment, processes and materials used. The recommendations in this code of practice cannot ensure the health and safety of students and employees without proper training and supervision by the teacher in charge. It is essential that the teacher has recognized accredited training in health and safety.

This code of practice has been written also for persons responsible for providing services, equipment and machinery to schools and similar establishments, and for persons employed to work in these establishments. If similar resources are used in other school departments and colleges of further education, the recommendations of this standard can be applied to these departments. They should also be applied where students are undergoing initial teacher training.

Risk assessment is an important part of health and safety and all teachers should be aware of the Health and Safety Executive (HSE) booklet *Five Steps to Risk Assessment* (INDG 163). In design and technology teaching areas, risk assessments should be applied to the working environment, equipment, processes, techniques, and activities.

Practical experience provides opportunities to introduce students to concepts of risk assessment and safe working methods. Students should be encouraged to develop their understanding of risk assessment processes. Through application of this process, students can be trained to use appropriate control measures to minimize risks to themselves and others. It is essential that teachers are fully conversant with hazards in the area that they supervise, and that they plan, organize, control and monitor the work so that risks can be controlled.

Whilst this standard is meant to be comprehensive, it does not preclude the development and introduction of new technologies so long as appropriate risk assessments are made and the employer accepts their introduction.

This code of practice is intended to be a useful guide to teachers in design and technology establishments, and should contribute to prevention of accidents and dangerous occurrences. It is recommended that employers and employees incorporate the recommendations of this code of practice into their working environment.

This new edition of BS 4163 has been fully updated to reflect current practice. In particular, attention is drawn to the following clauses and subclauses. (Please note, this is not an exhaustive list of all the technical changes in the document.)

2.8 First aid. Recommendations on first aid provision clarified, in particular, provision of eye wash facilities.

3.1 Maximum student : teacher ratio updated.

3.2.6 Liquefied petroleum gas. Recommendations brought up to date.

3.3 Fire. Recommendations brought up to date.

4.4.1 Floors. Additional guidance given regarding floors in textile areas.

4.5 Hazardous noise. Lower exposure action level reduced to 80 dB(A); guidance given on elimination, protection, and establishment of hearing protection zones.

4.6 Vibration. New subclause.

5.2 Electrical installations. Guidance brought up to date.

5.2.5 Work area emergency switching systems. These are not needed in staff only preparation areas. Also they should not negate other safety systems (e.g. braking).

5.3.3 Interlocked ventilation systems. Attention is drawn to current regulations.

Clause **8** restructured to separate equipment for use with food and equipment for use with textiles.

8.1.4 Fixed electrical appliances (for food and textiles). Recommendations brought up to date.

8.2.1 to **8.2.5** Ovens and blast chillers. New subclauses.

8.2.9 Portable food blending machines. New subclause.

8.3.3 Portable sewing machines. Guidance now extended to cover also portable overlocking, embroidery and embellisher machines.

9.5 Portable biscuit cutters. New subclause.

9.11.2 There are now new provisions regarding the use of portable routing machines mounted in a table.

9.13 Hot melt glue guns. New subclause.

10.1 Wood dust exposure limit. Maximum exposure limit (MEL) now categorized as workplace exposure limit (WEL) (also in **17.5.2**).

10.3 Moulding machines (spindle moulders). While these are not to be used in schools, provisions have been added that further education colleges may wish to undertake their own risk assessment to enable these machines to be used.

10.4 Planing and thicknessing machines. These are now all required to have enhanced safety features, such as a braked motor.

10.6 Sawing machines. These are now all required to have enhanced safety features, such as a braked motor.

12.2.4 Fuel tanks. New recommendations given on fuel storage.

13.1 Injection moulding machines. Guidance extended to cover injection and extrusion moulding machines.

13.7 Blow moulders. New subclause.

13.8 Hot air plastics welding. New subclause.

14.3 Plasma arc cutting. New subclause.

14.6 Low temperature casting. New subclause.

15.3 Soft soldering. Recommendations given to prevent exposure to rosin based solder flux fumes, normally by provision of local exhaust ventilation.

Clause **16** Computer-operated equipment. New clause. This includes recommendations regarding laser cutters (see **16.1**), rapid prototyping including 3D printers, stereolithography, laser sintering and laminated object manufacture (see **16.2**), rapid prototyping (printing) machines (see **16.3**) and computer numerically controlled (CNC) machines (see **16.4**).

17.2 Asbestos and products containing asbestos. Text updated and reference made to the Control of Asbestos Regulations 2006.

Hazard warnings

WARNING. Students may only use the following machines when they have been assessed and the assessment has shown that they are competent, and they are under appropriate supervision of specifically trained staff:

- portable grinders (e.g. angle grinders) (see **9.3**);
- rotating (circular) portable saws (see **9.4**);
- portable biscuit cutters (see **9.5**);
- reciprocating portable saws (e.g. jig saws) (see **9.6**);
- portable planing machines (see **9.10**);
- portable routers (see **9.11**);
- band sawing machines (see **10.6.1**);
- chop and radial arm sawing machines (see **10.6.4**);
- sawing machines, power hacksaws and metal cutting bandsaws (see **11.6**).

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the statutory legislation listed in Clause **19**.

Section 1: General

1 Scope

This British Standard code of practice provides recommendations and guidance for persons responsible for planning services, equipment and machinery and for persons who may use these in design and technology facilities in schools and similar establishments.

Design and technology facilities include all teaching areas and preparation areas where materials are manipulated and processed, equipment is used and design and/or manufacturing takes place (e.g. food, textiles, graphics, electronics, technology, craft, engineering, manufacturing and computer areas).

NOTE The recommendations cover the supply and safe use of equipment, machine tools and materials and chemicals, personal protection and safety management, with particular reference to the hazards involved.

Section 2: Health and safety management

2 Health and safety management

2.1 Risk assessment

The Management of Health and Safety at Work Regulations (MHSWR) 1999 require that employers carry out an assessment of the risks to health and safety of employees and other persons. Measures then have to be taken to comply with the requirements and prohibitions imposed by, or under, the relevant statutory provisions. The relevant statutory provisions are:

a) the general duties of the Health and Safety at Work etc. Act 1974, that require employers to ensure, as far as reasonably practicable, the health, safety and welfare at work of employees and the health and safety of other persons;

b) the duties imposed by any health and safety regulations relevant to the employer's activities.

The Management of Health and Safety at Work Regulations 1999 require that young persons (persons under 18) are not exposed to increased health and safety risks as a consequence of lack of experience, absence of awareness of risks or lack of maturity. Strictly, the regulations only apply where young persons are employed or are taking part in a work experience scheme, but the principle is the same for students. Employers are required to assess the risks to which young persons are exposed, and to implement measures to protect their health and safety, taking into account lack of experience and maturity.

2.2 Hazards, risks and risk control measures

2.2.1 Hazards

NOTE Hazards are anything with the potential to cause harm to persons.

Hazards should be identified as the first step in carrying out a risk assessment. When all hazards have been identified it should be decided first whether they can be eliminated. If the hazard can be eliminated then there is no risk and the risk assessment process is complete (e.g. use of a battery operated drill eliminates the hazard of mains electricity).

2.2.2 Risk

If a hazard cannot be eliminated then the risk should be assessed. The risk is the likelihood of injury or damage occurring and the severity of the consequences. The risk depends on the prevailing circumstances and the risk control measures in place. The risk is affected by the number, experience and level of responsibility of the students in the teaching environment.

2.2.3 Risk control measures

Risk control measures can be engineering control measures (e.g. guarding) or procedural measures such as systems of work in conjunction with instruction and supervision and personal protective equipment. Risk control measures should be taken in the following order.

a) If possible, eliminate the hazard.

b) If not possible, substitute with a safer alternative.

c) If not possible to eliminate the hazard, reduce risks "at source", using engineering controls if practicable.

d) Institute procedures and systems of work in conjunction with instruction and supervision.

e) Use personal protective equipment.

2.3 Carrying out a risk assessment

Although it is essential to assess all risks and to take action as appropriate, many duties can be considered to be goals or targets that should be met "as far as reasonably practicable", or through exercising adequate control. "As far as reasonably practicable" and "adequate control" should be understood to mean that up-to-date good practice is applied as appropriate.

Where good practice is not specified or obvious, the seriousness of the risk should be weighed against the difficulty and cost in terms of time, effort and money, of reducing the risk. In these cases, reasonable risk reducing measures should be pursued, up to the point where any further measures would be disproportionate to the benefits expected. If there are five or more employees involved, the significant findings of the assessments should be recorded.

When carrying out a risk assessment it should be remembered not to consider anything as absolutely safe or of zero risk.

The Management of Health and Safety at Work Regulations 1999 specify that risk assessment includes identifying hazards and applying appropriate risk controls; satisfying legal requirements; and structuring risk control decision making. Risk assessments should be carried out in the following sequence.

- Step 1: look for the hazards.
- Step 2: decide who might be harmed and how.
- Step 3: evaluate the risks and decide whether the existing precautions are adequate or whether more should be done.
- Step 4: record the significant findings.
- Step 5: review the assessment and revise if required.

NOTE 1 The HSE leaflet, Five Steps to Risk Assessment *(INDG 163), provides guidance on carrying out risk assessments.*

NOTE 2 CLEAPSS has produced Model Risk Assessments for Design and Technology in Secondary Schools and Colleges.

NOTE 3 The Design and Technology Association has produced Risk Assessment in Secondary School Design and Technology Teaching Environments.

2.4 Health and safety arrangements

NOTE 1 Employers are legally required to make appropriate arrangements (with regard to the nature of the activities and the size of the undertaking) for effective planning, organization, control, monitoring and review of preventative and protective health and safety measures. If five or more persons are employed, the arrangements should be recorded.

Heads of department in design and technology should understand their health and safety responsibilities, and how these relate to the tasks of the health and safety coordinator at the school or similar establishment.

Employees working in practical areas should continuously monitor the effectiveness of the preventative and protective measures in place. A competent employee should carry out a formal review at least once each term to ensure that the measures remain effective.

NOTE 2 Occasional inspections by specialist health and safety advisers can help maintain standards and keep employees informed of developments in health and safety legislation and good practice.

A review of reported injuries and incidents should be carried out as a useful method of reactive monitoring of the effectiveness of health and safety arrangements.

2.5 Health and safety assistance

Employers are legally required to appoint one or more competent persons to assist in carrying out measures to comply with health and safety legislation. Persons should be regarded as competent if they have sufficient training and experience or knowledge and other qualities to enable them to assist properly in carrying out the measures identified by the risk assessments. If possible, persons who provide assistance should be employees.

2.6 Health and safety training

NOTE 1 All employers are required under the Health and Safety at Work etc. Act 1974 to provide, as far as reasonably practicable, all information, instruction, training and supervision necessary to ensure the health and safety at work of their employees.

NOTE 2 Employers are required, under the Management of Health and Safety at Work Regulations 1999, to take into account all employees' capabilities with regard to health and safety.

It is essential that staff are competent to undertake the tasks expected of them. Proper health and safety training should be provided to employees on induction into the school or similar establishment and when exposed to any new or increased risks.

Design and technology has training standards approved by the Training and Development Agency (TDA) and these are published by the Design and Technology Association (D & T Association) (*Health and Safety Training Standards in Design and Technology*). The standards provide national recognition to teachers and support staff, and cover all elements of training. Reaccreditation is required on a five-year basis.

All teachers should be trained in safe use of equipment, machinery and processes during initial training, or by in-service training. Teachers involved in teaching any aspects of food handling should have at least a recognized food safety certificate; this is included in the TDA/D & T Association publication *Health and Safety Training Standards in Design and Technology*.

2.7 Reporting accidents and dangerous occurrences

All significant accidents, work related ill health and dangerous occurrences should be reported and recorded either by completion of an employer's report form or by entering details in an accident book. In each case consideration should be given to the circumstances of the accident and what action should be taken to prevent reoccurrence.

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995 require certain types of incidents to be reported to the HSE.

NOTE See the HSE free leaflet HSE 31 RIDDOR Explained.

2.8 First aid

NOTE 1 The Health and Safety (First Aid) Regulations 1981 require employers to ensure that there is sufficient first aid provision for employees. Sufficient first aid should also be provided for students.

A first aid container should be readily available to each design and technology area.

NOTE 2 See HSE publication L74 First Aid at Work. Health and Safety (First Aid) Regulations 1981. Approved Code of Practice and Guidance, *1997*.

Eye wash facilities should be available where required (e.g. by using a suitable mains cold water tap or, where this is not available, by proprietary eye wash bottles). First aid materials conforming to HSE publication L74 should be provided and there should be a number of persons competent to provide first aid appropriate to the risks. At least one person holding a current first aid certificate or who has been trained in emergency first aid should always be available to attend and to provide first aid when design and technology rooms are in use.

NOTE See Department for Education and Skills (DfES) publication Guidance on First Aid for Schools.

Section 3: Planning and services

3 Planning and design

3.1 General

The number of students in any one work area should be carefully considered to ensure safe working and effective supervision.

In England and Wales the recommended maximum number of students in any one work area is 20 students with one competent, qualified teacher.

In Scotland and Northern Ireland there are legal requirements for all classes in practical subjects to be restricted to a maximum of 20 pupils.

In Scotland *The Schedule of Salaries and Conditions of Service for Teachers in School Education* states that classes in practical subjects should not exceed 20 pupils. This is based on the Schools Scotland Code 1956 Regulation 15(2).

In Northern Ireland, the Department of Education – Northern Ireland provides guidance on class sizes in practical subjects for post-primary schools in Circular 2004/05 *Class sizes in practical subjects in post-primary schools*, which can be summarized as follows.

Under Regulation 15 of the Secondary School (Grant Conditions) Regulations (Northern Ireland) 1973:

- a practical subject includes science, technology and design, home economics, art and design, physical education and music;
- the number of pupils under instruction by one teacher should not exceed 20 for a class in a practical subject except where approved by the Department.

The Department is prepared to approve class sizes in excess of 20 where:

- a class of pupils is under instruction in a practical subject and are not involved in practical activities;
- the activities are unlikely to present a risk to the health and safety of the pupils in the class; and
- classrooms meet the required standards as set out in paragraph 6 of Circular 2004/05.

Risk assessments should be carried out to determine the appropriate number of students in the work area.

This should be carried out in accordance with the D & T Association publication *Risk Assessment in Secondary School Design and Technology Teaching Environments*. The risk assessment should take the following factors into account:

- the size and layout of the work area;
- the size and number of items of furniture and equipment in the work area;
- the type of activities carried out in the work area;

- the age and ability of the students;
- the competence and experience of the teacher;
- the extent of technician or other appropriate support;
- whether students with special needs are present;
- whether there are students whose first language is not English;
- the behaviour of the students.

Detailed design of work areas should conform to the current Department for Education and Skills (DfES) Building Bulletins, or the corresponding recommendations for Scotland and Northern Ireland, as applicable. These include dimensions for safe working areas around individual machines, furniture and equipment for new or refurbished facilities, and floor area ranges for varying group sizes. Attention is drawn to the requirements of the Disability Discrimination Act 1995.

3.2 Storage

3.2.1 General

Storage should be provided for bulk supplies of materials and student's projects. Materials and projects should be stored safely.

The amount of any stored substance should be as low as possible in accordance with purchasing and curriculum requirements. Inventories should be reviewed at least once each term, and redundant stocks disposed of safely in accordance with the manufacturer's instructions.

NOTE 1 Attention is drawn to the Environmental Protection Act 1990.

It is essential to provide suitable access equipment for items that are stored at high level. Care should be taken to ensure that items are stored securely and that they do not protrude so that they could present a risk to the eyes, head or body.

It is essential to separate and store food components and products correctly. Provision should be made for storage of four categories of foods: dry and shelf stable foods, fresh fruit and vegetables, frozen foods and perishable foods. Inventories should be checked regularly at intervals depending on the type of food/product stored.

Suitable storage areas should be provided for chemicals, flammable liquids, liquefied petroleum gas (LPG), acetylene and oxygen. Each hazardous substance [e.g. highly flammable (liquid or gaseous), highly combustible, toxic, corrosive] should be kept apart from substances presenting a different type of hazard.

NOTE 2 Attention is drawn to the Health and Safety (Safety Signs and Signals) Regulations 1996, regarding the display of safety notices. The local health and safety adviser or fire prevention officer should be consulted.

If only very small quantities of some hazardous chemicals are required for occasional use, it may be appropriate to obtain supplies from other stores in the school or similar establishment. However, all storage in design and technology areas should conform to the appropriate storage requirements.

3.2.2 Materials

Storage of bulk materials such as timber and metals should be in an area separately designated and supplementary to the teaching area. The store should be adjacent to the work area with ready access both to it and to the outside to facilitate deliveries. Adequate racking for the storage of flat and round metal stock, timber planks, and wood, metal and plastics sheets should be provided. Ends should not protrude from the rack. Retaining bars or chains should be provided if vertical stacking is employed.

To preserve materials in good condition and to facilitate safe handling at all times, timber and plastics should be stored in unheated areas and metals in warm and dry areas. However, it is essential to provide a comfortable working environment in these areas.

3.2.3 Food

Dry and shelf stable foods (e.g. bread, bottled foods, canned foods) should be stored in dry, well ventilated rooms with a temperature range of 10 °C to 15 °C. These foods should not be stored on the floor and storage should facilitate rotation. The manufacturer's storage instructions should be followed.

Raw and unprepared fruit and vegetables should be stored away from other foods in a cool, dry and well ventilated area, not exposed to full sunlight and with a temperature range of 10 °C to 15 °C.

Frozen foods should be stored at a temperature between packs of at least minus 18 °C.

Perishable foods (e.g. fish, meat and poultry, dairy products, prepared fruits and vegetables, opened canned and bottled foods, uncooked or partly cooked pastries and dough products) should be stored with a core temperature of between 1 °C and 4 °C. Cook-chilled food should be stored between 0 °C and 3 °C.

All freezers, refrigerators and chillers should be regularly checked to ensure that the correct temperature is maintained.

Food stored in a refrigerator or freezer should be wrapped or placed in suitable containers and dated.

Raw and cooked foods should be kept apart at all times and separate handling equipment should be used for each. If only one refrigerator is available, raw foods should be stored on shelves below cooked foods.

Hot foods should not be placed in refrigerators or freezers.

Hot food should be covered, and cooled as quickly as possible, using a rapid cooler if available.

It is essential that sufficient refrigerator or chiller unit space is available to store perishable ingredients and/or finished food products belonging to students, during the school day.

Reheated food should be brought to at least 70 °C for at least two minutes. Hot food should be kept at a minimum of 63 °C.

3.2.4 Hazardous substances

NOTE Substances hazardous to health are classified and labelled under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (as amended) as follows:

- *irritant: prolonged or repeated contact can lead to reddening of the skin;*
- *corrosive: immediate contact corrodes skin and eyes;*
- *harmful: inhalation of fumes/dust or ingestion of substances can be harmful to health;*
- *toxic, including carcinogenic: inhalation of fumes/dust or ingestion of even small quantities can lead to serious illness or death;*
- *oxidizing: contains oxygen; makes fires burn quicker and more violently.*

If possible, schools should avoid using hazardous substances. Non-hazardous or less hazardous substances should be chosen in preference to hazardous substances.

Hazardous substances should be stored and used in accordance with the manufacturer's instructions. Guidance on storage of hazardous substances in technology can be found in the CLEAPSS publication *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*.

If use of a hazardous substance is unavoidable, attention is drawn to the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended) which require an assessment of the risks associated with the use and storage of the substance.

It is essential to implement risk control measures including the following.

- Storage should be secure to prevent unauthorized access.
- Hazardous substances should be stored separately so as to avoid incompatible materials coming into contact with one another [e.g. acids and sodium hypochlorite (bleach)].
- Adequate local exhaust and general ventilation should be provided and maintained.
- Safe systems of work incorporating instruction, training, personal protective equipment and record keeping should be in use.
- Emergency procedures should be provided in case of spillage or accident.
- Emergency eye irrigation and body washing facilities should be available.
- Pre-prepared spill kits should be used if possible.

Main stocks of hazardous substances should be kept in a lockable store provided with ventilation at high and low levels on an outside wall. Provision should be made for spill containment within the store. Bottles of hazardous substances of 1 litre capacity or higher should be stored at low level, in a position where they cannot be knocked.

Only sufficient supplies of hazardous substances for immediate use should be kept in the work area. Supplies should be stored in strong, locked containers in which any spillage can be retained. Containers should be unbreakable. Glass containers, if used, should be carried in an unbreakable container or plastics bucket. Acids should be stored and used close to a water supply. The Control of Substances Hazardous to Health Regulations 2002 (as amended) require local exhaust ventilation systems to be regularly maintained, and inspected by a competent person at least every 14 months.

3.2.5 Flammable liquids and highly flammable liquids

NOTE The Dangerous Substances and Explosive Atmospheres Regulations 2002 are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used, or present, in the workplace. Dangerous substances are substances or preparations which are explosive, oxidizing, extremely flammable, highly flammable or flammable. They include petrol, liquefied petroleum gas, solvent based paints and varnishes, and dusts which when mixed with air could cause an explosive atmosphere.

3.2.5.1 Flammable liquids

NOTE Substances described as "flammable" burn but do not give off sufficient vapours at normal room temperatures to form an explosive concentration. Flammable liquids include paraffin, white spirit, turpentine substitute and oil.

It is essential that flammable liquids are stored in a secure area away from heaters, lights and combustible materials (e.g. paper, cardboard, fabric, wood). It is also essential to ensure that they are kept away from naked lights and that smoking is prohibited.

The risks from spillage should be minimized by using small quantities of flammable liquids and by replacing lids on containers quickly after use. Contact with the skin should be avoided by wearing suitable gloves. Any spillage should be cleared up immediately.

3.2.5.2 Highly flammable liquids

NOTE 1 Substances described as "highly flammable" are easily ignited at room temperature and are possibly explosive. Fire and inhalation hazards are much higher than with flammable liquids, and highly flammable liquids should not be used if possible. Highly flammable liquids include cellulose paints/thinners, methylated spirits and petroleum-based adhesives.

Quantities of highly flammable liquids in storage should be kept to a minimum.

Highly flammable liquids should be stored in closed containers in a secure, purpose built highly flammable liquids store, or, if there are no more than 50 litres, in a fire resisting, spill resistant cabinet marked with a "highly flammable" warning symbol. Care should be taken to ensure that all containers are suitable and properly marked with the "highly flammable" warning symbol. Containers should be returned to the store or storage cabinet immediately after use. Storage cabinets should be kept locked or should be in a locked storeroom.

If highly flammable liquids are to be used, this should be outdoors if possible. Petrol tanks should always be filled, and liquids transferred between containers, outdoors, well away from buildings and sources of ignition. Adequate ventilation should be ensured by only using highly flammable liquids in open workshops, by opening windows, and by operating any extractor fans. Care should be taken to ensure that any electrical extractor fans are not a source of ignition.

Highly flammable liquids should not be used in basements, pits or any other areas below ground.

NOTE 2 Vapours from highly flammable liquids are heavier than air and accumulate low down, and can form explosive concentrations.

Highly flammable liquids should not be used close to any source of ignition, naked lights, welding areas or electrical equipment, and smoking should be prohibited. Combustible materials (e.g. paper, cardboard, fabric, wood) should not be allowed to become soaked with highly flammable liquids.

Risks from spillage should be minimized by using small quantities and by replacing lids on containers. Purpose designed dispensing containers with spring closed caps should be used if possible. Contact with the skin should be avoided by wearing suitable gloves. Spills should be cleared up immediately and all contaminated rags, paper towels, etc., should be disposed of in an appropriate waste container outside the building.

3.2.6 Liquefied petroleum gas (LPG)

NOTE 1 Liquefied petroleum gas [propane and butane, and MAPP (methyl-acetylene-propadiene) gas] can be used for heating purposes and as an aerosol propellant. Propane is supplied in red cylinders, and at normal temperatures is stored at about 7 bar. Butane is supplied in blue cylinders, and is stored at about 2 bar. MAPP gas is supplied in yellow cylinders. The test pressures for propane and MAPP gas are 25 bar and 22 bar respectively.

The following should be taken into consideration when handling liquefied petroleum gas.

Leaks and/or spills of LPG from cylinders or pipework and fittings could create an explosive mixture in the building.

Cylinders of LPG involved in a fire can explode violently.

Cylinders of LPG are heavy and present moving/handling and toppling hazards.

Escaping vapour from cylinders and aerosols can ignite violently.

Skin and eyes can receive cold burns from rapidly evaporating LPG.

LPG is an asphyxiant.

Burning LPG can produce hazardous fumes.

LPG is heavier than air and sinks to low level. It can accumulate in cellars, pits, drains or other depressions.

Suitable measures should be taken to prevent tampering with and vandalism of LPG cylinders at the design/installation stage. The measures should take into account the general security of the storage area.

A warning sign "highly flammable LPG" should be displayed on LPG cylinder storage. LPG cylinders should not impede or endanger any means of escape from buildings or adjoining areas. Portable fire fighting equipment should be readily available in the LPG storage area.

NOTE 2 Advice on provision and use of fire fighting equipment can be obtained from the local fire authority.

On fixed LPG installations, housings should be fire resistant and well ventilated, and should conform to the requirements of the local fire authority.

LPG should be stored and used in a well-ventilated position so that any small leaks can disperse diluted to well below the flammable concentration. Signs prohibiting smoking should be displayed in the storage area. LPG should preferably be stored outdoors and away from combustible materials, corrosive materials and oxygen cylinders, and in accordance with LP Gas Association Code of Practice No. 7, 2004. It is essential that other materials (especially combustible materials) are not stored close to LPG cylinders, and do not obstruct or restrict natural ventilation of the storage area.

LPG vapour is denser than air and cylinders should not be stored below ground level or close to drains, cellars or basements.

LPG cylinders should not be subjected to mechanical damage or high temperatures, or dropped. Cylinders should be kept in trolleys and/or secured upright so that they cannot be knocked over. Care should be taken to ensure that the valves of empty cylinders are closed to prevent ingress of air, which could form an explosive mixture.

Numbers of stored LPG cylinders should be kept to a minimum. Not more than one spare cylinder should be kept for each application.

The Dangerous Substances and Explosive Atmospheres Regulations 2002 cover the use and storage of LPG. Although not specifically required by the Regulations, it is recommended that no more than eight disposable canisters should be stored together.

NOTE 3 See BS 5482-1 for more information.

*NOTE 4 See Note to **3.2.5**.*

3.2.7 Oxygen and acetylene cylinders

The following should be taken into consideration when handling oxygen and acetylene cylinders.

Compressed oxygen cylinders can explode violently if damaged or if involved in a fire, or could become a missile if the valve is damaged.

Oxygen leakage makes fires burn more quickly and more violently.

Acetylene cylinders can explode violently if involved in a fire.

Acetylene leaks can form an explosive mixture in buildings.

Cylinders are heavy and present moving/handling and toppling hazards.

Numbers of oxygen and acetylene cylinders should be kept to a minimum. Cylinders should be stored in well-ventilated areas away from combustible materials.

"Compressed gas" and "flammable gas" warning signs should be displayed at cylinder stores.

Cylinders (even if empty) should be kept in a safe, well-ventilated place, preferably outside. Cylinders should not be stored below ground level, or next to drains, basements or other low-lying places.

Cylinders should not be subjected to mechanical damage or high temperatures, or dropped. Cylinders should be kept in trolleys or secured upright so that they cannot be knocked over.

Acetylene in cylinders is dissolved in a liquid and cylinders should be kept with valves uppermost at all times.

NOTE *See Note to* ***3.2.5****.*

3.2.8 Glass reinforced plastics materials

The following should be taken into consideration when handling glass reinforced plastics materials.

Resins and catalysts can be classified as hazardous substances.

Some plastics can give off toxic fumes if overheated or involved in a fire.

Inhalation of fumes and vapours can be hazardous. Individuals can suffer respiratory sensitization and in some cases the effects can be irreversible.

Adhesives containers can split and leak.

Chemicals for glass reinforced plastics work can constitute a fire hazard.

Splinters of material can issue from plastics sheets if they are snapped.

Glass reinforced plastics materials should be stored in cool, dry conditions away from direct heat sources.

Catalysts (organic peroxides) and accelerators (cobalt naphthenate) used for glass reinforced plastics work should be stored in separate (preferably metal) cupboards where any spillage can be retained.

Peroxides should be stored only in vented containers away from any flammable materials and should not be placed in sunlight or near to any source of heat. Large quantities of catalysts, resins and solvents are a fire hazard and storage of these should be avoided.

3.2.9 Casting and forging materials

Sufficient storage area should be provided for forge fuel and moulding sand. Areas around casting and forging equipment should be kept clear.

3.2.10 Portable equipment

Appropriate storage should be provided for portable equipment (e.g. hand tools, power tools and machine accessories). Specially designed rack systems should be devised to check returned items.

Power hand tools should be securely stored to prevent unauthorized use.

3.2.11 Storage of personal clothing

Suitable and sufficient storage for clothing, school bags and cases should be provided away from the main practical work area. All persons working in specialist areas should use appropriate protective clothing.

3.3 Fire

3.3.1 General

NOTE The management of risks from fire is covered by the following legislation:

- *In England and Wales: the Regulatory Reform (Fire Safety) Order 2005;*
- *In Scotland: the Fire (Scotland) Act 2005;*
- *In Northern Ireland: the Fire and Rescue Services (Northern Ireland) Order 2006.*

Under the fire safety legislation a fire risk assessment is required to be undertaken in order to identify the means of fire prevention and the necessary fire precautions. A fire risk assessment would normally be undertaken for the whole school. This should take account of the specific fire risks in design and technology areas.

Guidance on carrying out fire risk assessments in educational establishments is given in *Fire Safety Risk Assessment – Educational premises*, published by the Department for Communities and Local Government.

3.3.2 Fire hazards

The following fire hazards are of particular importance in design and technology areas:

a) Sources of ignition:
   - hot surfaces;
   - electrically generated sparks;
   - mechanically generated sparks (e.g. from abrasive wheels);
   - naked flames (e.g. in welding);
   - hot materials (e.g. in heat processes).

b) Sources of fuel:
   - flammable liquids (e.g. cooking oils, solvents, petrol);
   - flammable gases (e.g. acetylene, propane);
   - wood shavings and dust, and plastics dust;
   - textiles and soft furnishings.

c) Sources of oxygen:
   - natural air flow and forced air flow [e.g. local exhaust ventilation (LEV)];
   - oxidizing chemicals (e.g. catalysts for glass reinforced plastics work);
   - oxygen cylinders (e.g. for welding).

3.3.3 Fire risk control measures

Many of the risk control measures laid down in this standard for the management of services and specific activities are concerned with controlling the risk of fire. These include storage and use of flammable substances, the management of heat processes and the control of dust. These should be referenced in the fire risk assessment.

Fine particles of some dusts are combustible (e.g. wood, plastics and some metals) and can, in the right concentrations, ignite explosively and start a fire. Local exhaust ventilation systems for combustible dusts should be separate and not used for processes where sparks are generated. Sparks from grinders, etc., could ignite combustible dust causing an explosion in the ducting or collector. Dust should not be allowed to accumulate on electrical or other equipment as this can lead to overheating.

NOTE See HSE guidance document HSG 103, Safe handling of combustible dusts: Precautions against explosions.

3.3.4 Fire systems and procedures

The following fire systems and procedures are essential for design and technology areas:

a) appropriate fire detectors and fire alarms;

b) fire escape routes with the correct signs;

NOTE See BS 5499-4 for guidance on escape route signing.

c) fire fighting equipment and suitable arrangements for:

- preparing, communicating and testing procedures in case of fire;
- maintaining and testing fire equipment.

4 Working area environment

4.1 Lighting

4.1.1 General

It is essential to provide sufficient lighting in work areas. Escape lighting should be provided where appropriate.

The following levels of lighting should be provided.

- High intensity of natural light (500 lx) should be provided in food preparation areas. Fluorescent lighting with a minimum colour rendering index (Ra) of 80 should be provided to avoid distortion of food colours.
- At least 500 lx should be provided for normal bench and machine work (taking into consideration the stroboscopic effect of fluorescent lighting units).
- At least 500 lx should be provided in fabric work areas.
- 1 000 lx should be provided for fine bench and machine work.

NOTE Suitable task lights should be used to provide lighting at 1 000 lx.

Subdued lighting should be provided in forging, brazing and welding areas to enable colour changes in heated metals to be easily observed.

Sudden changes in intensity of illumination within work areas or at entrances and exits should be avoided. If possible, the recommended levels of illumination should be provided by natural light, supplemented by artificial lighting if required. Glare should be avoided.

Lighting units installed in storage areas should be mechanically protected.

Computer visual display units should be positioned away from glare and reflection from lights and windows. Window blinds should be provided where required. If it is probable that the computer room will be put into prolonged use, provision of anti-glare category 2 light fittings should be considered. The Health and Safety (Display Screen Equipment) Regulations 1992 (as amended) provide guidance (see HSE document L26).

4.1.2 Supplementary lighting

Supplementary lighting should be provided for machine tools and equipment if the main room lighting is not sufficient. Supplementary lighting should conform to BS EN 60204. Lamps should not operate at more than 50 V a.c. If the switch for the supplementary light is not easily accessible to the machine tool operator, another switch should be provided adjacent to the light source. Lighting should be provided with a deep shade to prevent glare from polished surfaces.

4.2 Heating

Work areas should be maintained at a temperature comfortable to work in when appropriate protective clothing is worn.

NOTE 1 Attention is drawn to the Workplace (Health, Safety and Welfare) Regulations 1992, and the HSE Approved Code of Practice and Guidance (L24), and also to the Education (School Premises) Regulations 1999.

Food preparation should not be carried out in close proximity to fan assisted heating units because there is the potential for food contamination from airborne dust.

NOTE 2 Fan assisted heating should be avoided where dust-producing activities are carried out.

4.3 Ventilation

Local exhaust ventilation should be provided if a risk assessment shows that this is required in order to comply with the Control of Substances Hazardous to Health Regulations 2002 (as amended) or to ensure the safety and comfort of the operators for the following equipment and processes:

- cooking appliances that give off steam, oil, grease, odour and heat (the ventilation system for food technology should include a fan of sufficient capacity to ensure the fume load is removed from the equipment);
- equipment for heat treatment, including equipment for brazing, forging, welding, cutting, soldering and casting;

- woodworking machines, including machines for sawing, sanding, routing, planing and thicknessing;
- chemical processes and procedures, including acid pickling, processes involving plastics, paint spraying, and procedures producing engine exhaust emissions;
- metalworking machines (used for grinding and polishing);
- laser and other cutters.

The local exhaust inlet should be sited as close as possible to the source of contaminant. If venting to the outside, care should be taken not to harm persons outside or in another part of the building. It is essential that air is admitted to the room to compensate for air exhausted to the outside.

NOTE 1 For information on airborne contaminants that could present health risks, and on the levels of these permitted in industrial environments, see HSE Guidance Note EH40, Workplace Exposure Limits.

NOTE 2 For information on local exhaust ventilation see HSE Guidance Books HSG 37, An Introduction to Local Exhaust Ventilation, *and HSG 54,* The Maintenance, Examination and Testing of Local Exhaust Ventilation.

The Control of Substances Hazardous to Health Regulations 2002 (as amended) require ventilation systems to be thoroughly examined at least every 14 months to ensure efficient operation to their original specifications. The Regulations require records of maintenance to be kept for at least five years, and any health surveillance records for individuals for 40 years.

NOTE 3 Additional ventilation or air conditioning might be required where computers are used.

4.4 Surfaces

4.4.1 Floors

Floors in areas where design and technology activities occur should be on one level. Floors should be provided with a non-slip surface and this should be maintained in good condition. Floors in heat treatment areas should be of fire-resistant material. Floors in food handling areas should be washable and should be washed at the end of every day on which food preparation has taken place.

Spilt oil, water or chemicals should be cleaned away immediately. Accumulations of waste materials should be removed from floors each day. Floors should be kept free of obstacles and tripping hazards.

Duckboards should not be used.

Floors in textile areas should not be carpeted. This is important because of the risk of injury from needles or pins caught in the pile.

Further guidance is given in HSE Education Information Sheet No. 2 (EDIS 2) *Preventing slip and trip incidents in the education sector*.

4.4.2 Ceilings, walls and work surfaces

Ceilings, walls and work surfaces of work areas should be smooth, clean and able to provide a good level of reflected light, except for areas used for heat treatment processes, which should be provided with non-reflective surfaces. Walls adjacent to heat treatment areas should be free of flammable materials. Work surfaces in food handling areas should be smooth and easy to clean. Work surfaces should not be edged with wood or plastics lipping. Ceilings and walls should be suitable for regular cleaning. Separate, clearly coded cutting boards should be provided for working with different foods.

4.5 Hazardous noise

High levels of noise can cause permanent hearing loss. This can take years to become serious but is irreversible. In general, if persons about two metres apart are required to raise their voices to carry out a normal conversation it might be necessary to implement controls under the Control of Noise at Work Regulations 2005, depending on how long they are exposed. The Regulations require the risks of hearing damage to be assessed.

NOTE The risk of hearing damage depends on the sound level and the length of exposure. Some impact type sounds can cause hearing damage instantaneously (e.g. gun shots, heavy hammer blows on resonant objects). The Control of Noise at Work Regulations 2005 specify duties of employers and employees if the employee's daily noise exposure reaches specific daily or weekly "action levels" and "limit values" as follows:

a) lower exposure action values:
- *daily or weekly exposure of 80 dB(A);*
- *peak sound pressure of 135 dB(C);*

b) upper exposure action values:
- *daily or weekly exposure of 85 dB(A);*
- *peak sound pressure of 137 dB(C);*

c) exposure limit values:
- *daily or weekly exposure of 85 dB(A);*
- *peak sound pressure of 140 dB(C).*

Specific actions are required at each of the action levels. The limit value is the level which must not be exceeded (exposure limit values take account of any reduction in exposure provided by hearing protection).

Weekly personal noise exposure may be used in place of daily personal noise exposure where exposure varies markedly from day to day.

Employers have a duty under the Control of Noise at Work Regulations 2005 to ensure risk from the exposure of their employees to noise is either eliminated at source or, where this is not reasonably practicable, reduced to as low a level as is reasonably practicable. Where employees are likely to be exposed to noise above the upper action value, employers are required to reduce exposure as far as reasonably practicable using organizational and technical measures other than personal hearing protectors. Where it is not reasonably practicable to reduce the level below the upper action value, personal hearing protectors are required to be provided and worn.

Where employees' daily noise exposure exceeds the lower exposure action value, employers are required to make hearing protectors available on request and provide employees with adequate information, instruction and training about risks to hearing, action to minimize noise risk, and how to obtain ear protectors. At the lower exposure action value, employees should be encouraged to use personal hearing protectors, but use is not mandatory.

Employers are required to ensure employees are not exposed to noise above an exposure limit value, or if it is exceeded they are required to immediately reduce exposure to noise to below the exposure limit value, identify why it was exceeded, and modify the control measures to stop it being exceeded again.

In any area where the exposure limit value is likely to be exceeded, employers are required to mark hearing protection zones with suitable notices.

4.6 Vibration

Prolonged and regular exposure to hand/arm vibration (HAV) can affect the operator's health. HAV is vibration transmitted from work processes into workers' hands and arms. For example, it can be caused by operating hand held power tools, hand guided equipment or by holding materials being processed, e.g. on pedestal grinders. Regular and frequent exposure can lead to a range of conditions collectively known as hand/arm vibration syndrome (HAVS). This is most likely when contact with a vibrating tool or work process is a regular part of the person's job. Occasional exposure is unlikely to cause ill health.

The Control of Vibration at Work Regulations 2005 require employers to assess the vibration risk to employees and, where necessary, implement appropriate control measures.

NOTE The risk of damage from hand/arm vibration depends on the level of vibration and the period of exposure. The Control of Vibration at Work Regulations specify an "action value" and a "limit value" as follows:

a) daily exposure action value: 2.5 m/s² A(8).

b) daily exposure limit value: 5 m/s² A(8);

In the assessment of vibration risk, it is necessary to decide if employees are exposed above the daily exposure action value and, if they are, to introduce a programme of controls to eliminate risk, or reduce exposure to as low a level as is reasonably practicable; and to provide health surveillance (regular health checks) to employees who continue to be regularly exposed above the action value or otherwise continue to be at risk.

If the assessment shows employees are likely to be exposed above the daily exposure limit value, the employer is required to take immediate action to reduce exposure below the limit value.

Several pieces of equipment/processes used in design and technology can lead to hand/arm vibration, e.g. angle grinders, some sanders and using a pedestal grinding machine. However, exposure times are likely to be fairly short and therefore action levels are normally unlikely to be exceeded. They can be exceeded where a technician uses equipment when preparing work for students. This should be controlled by limiting the period of exposure.

5 Services

5.1 General

Services (electricity, gas, water and compressed air, provided within the work area by pipes and ducts) should be colour coded as specified in BS 1710. Where risks cannot be controlled in other ways (e.g. verbal instructions, suitable guards) it is essential that safety signs are provided.

NOTE Attention is drawn to the Health and Safety (Safety Signs and Signals) Regulations 1996.

Fire exit and emergency escape route signs should be in accordance with BS 5499-4.

5.2 Electrical installations

5.2.1 General

NOTE 1 New fixed installations and alterations should conform to BS 7671. Attention is drawn to the Electricity at Work Regulations 1989.

Socket-outlets should be supplied through a non-time delayed residual current device with a rated residual operating current not exceeding 30 mA ($I_{\Delta n}$) and an operating time not exceeding 40 ms at a residual current of $5I_{\Delta n}$ as specified in BS 7288, BS EN 61008-1 or BS EN 61009-1.

NOTE 2 Attention is drawn to the Electricity at Work Regulations 1989 with regard to the maintenance of electrical systems and equipment.

Inspections and tests on fixed electrical installations and equipment should be carried out at least once every five years by a competent person in accordance with the *Guidance Notes to BS 7671*, published by the Institution of Electrical Engineers.

NOTE 3 The frequency of inspections and tests of portable equipment depends on the design and use of the equipment (see HSE Guidance Book HSG 107).

Electrical equipment should only be used in the intended environment.

Protective conductor current from the power supply circuits of computers should be taken into consideration when selecting residual current devices, to prevent unwanted tripping to circuits supplying computers. Consideration should be given to the provision of local residual current devices to reduce the risk of problems associated with information technology equipment in the event of loss of supply.

Special precautions should be taken in areas where equipment with high protective conductor current (e.g. information technology equipment, electronic office equipment, process control equipment) is used. See BS 7671:2001, Section 607, and especially paragraph **607-02-06**.

If there is a risk of water and/or solids ingress (including use of equipment outdoors), the equipment should have an appropriate ingress protection (IP) rating. For details of specifications, and of tests to verify degrees of protection, reference should be made to BS EN 60529.

All portable electrical equipment should be correctly fused.

5.2.2 Food technology areas

Electrical installations in food areas should conform to BS 7671. Socket outlets should be supplied via a non-time delayed residual current device with a maximum tripping current of 30 mA. A maximum tripping current of 10 mA should be used in areas where water might be present.

Where a risk assessment indicates the need, consideration should be given to installing an overall main switch for food rooms. If there is an overall main switch, refrigerators, freezers and appliances with clocks and timers should be supplied by separate circuits which are not under the control of the overall main switch. Electric cookers require individual circuits at the correct rating to match the appliance. There should be a suitable electrical supply for gas cookers to supply clocks and timers.

All electrical equipment should be positioned away from sinks. Care should be taken to ensure that working areas and electrical sockets are positioned so that electric cables do not cross cookers or other hot surfaces.

Warning signs should be displayed adjacent to types of hotplates that show no visible signs when in operation.

Fixed appliances (e.g. cookers, washing machines and dryers) should be installed and inspected at regular intervals (usually every 12 months) by a qualified person.

The length of flexible cords of portable equipment should be as short as is reasonably practicable and they should be frequently inspected to ensure they are in good condition. All portable equipment should be unplugged if not in use, and before making adjustments or cleaning. Portable electrical equipment should be inspected regularly and tested periodically (usually every 12 months).

Electrical equipment should not be used with damp or wet hands.

5.2.3 Computer rooms

The electrical supply to computer rooms should conform to BS 7671:2001, Section 607. Any servers should be supplied through an individual dedicated supply that cannot be switched off unintentionally. Sufficient socket outlets should be provided in the room to avoid use of adapters or extension leads to computers and peripheral equipment (printers, scanners, control boxes, monitors, etc.).

5.2.4 Main work area switchgear

The electrical supply to work areas should conform to BS 7671. In each workshop area it should be possible to disconnect and isolate all electrical circuits that supply fixed equipment and socket-outlets by a single switch conforming to BS EN 60669-2-4 or BS EN 60947-3. The switch-disconnector should be readily accessible, clearly labelled “main switch”, and lockable in the “off” position. The switching device should not control lighting, space heating and specific socket-outlet circuits for cleaning purposes. Workshop areas without electrically operated fixed equipment and only a 230 V a.c. supply should be fitted with a switch-disconnector and an emergency switch-off system (see **5.2.5**) if there is rotating or other machinery (but not portable machinery) present.

5.2.5 Work area emergency switching systems

NOTE Attention is drawn to the Provision and Use of Work Equipment Regulations 1998.

Emergency switching systems should be provided in each separate student work area. Preparation areas for staff use only need not have any emergency switching system and should not be affected by the emergency system of any other area. The systems should switch off all circuits supplied via the switch-disconnector in an emergency. Critical circuits specifically installed to remove hazards (e.g. fume extractor fans, lighting, alarm circuits) should not be controlled by the emergency system.

The emergency switching device should be a remotely operated contactor or circuit breaker that opens when the coil is de-energized. The switching device should be controlled by a series of readily accessible push buttons evenly distributed around the work area, at an approximate height of 1.5 m, and clear of benches and machines. It should only be possible to reset the remotely operated contactor or circuit breaker by a single key-operated spring return switch sited within view of the work area it controls. A responsible person should retain the key. (See also BS EN 60204-1, BS 7671 and BS EN ISO 13850.) Push buttons should be conspicuous, and coloured red on a yellow mounting surface (see BS EN ISO 13850) and a safe condition sign conforming to BS 5499-5 should be in place adjacent to each switch.

The emergency stop system installed in a workshop should not negate any other safety systems fitted to machines, e.g. braking systems on hand fed wood cutting machines.

5.2.6 Electrical equipment for fixed machine tools

NOTE 1 The Provision and Use of Work Equipment Regulations 1998 (PUWER) require that, where appropriate, stop, emergency stop and emergency isolation systems should be installed for each item of work equipment.

Electrical equipment for fixed machine tools should conform to BS EN 60204-1.

Motor starters, switches and controls for fixed machine tools should conform to, and should be fitted in accordance with, BS EN 60204-1 and BS 7671. They should be readily accessible to the operator from the normal operating position and should not require the operator to reach over any moving parts of the machine. Emergency stop switches (which could be the normal "off" switch) should be provided at all fixed machines, and easily actuated by the user.

Equipment should be supplied via a fused switch-disconnector conforming to BS EN 60947-3, or a connection unit conforming to BS 1363-4, or a circuit breaker conforming to BS EN 60898, or a residual current operated circuit-breaker (RCBO) conforming to BS EN 61009-1.

Any controls or means of isolation not incorporated in the equipment should be not more than 2 m away from the equipment and positioned so that they can be operated safely while the equipment is in use. Each switching device should be clearly marked with its function and its associated machine/equipment.

Electric motors with a rating exceeding 0.37 kW should be provided with control equipment incorporating a means of protection against overcurrent in the motor.

NOTE 2 This recommendation does not apply to motors incorporated in current-using equipment conforming to a British Standard.

Means to prevent automatic restarting of an electric motor after certain types of stoppage (e.g. supply failure or voltage reduction) should be provided.

NOTE 3 This recommendation does not apply to automatic control devices that are set to start motors at some interval, and where other safety precautions are taken against unexpected restarting.

5.2.7 Electrical supplies for food technology equipment

Food technology equipment includes cookers, washing machines, dishwashers, etc., that have been installed via a permanent cable. It is essential that these appliances are fitted with an isolator that is clearly labelled to identify the appliance supplied, so that the appliance can be isolated.

Appliances supplied via a plug and socket should have the plug clearly labelled to identify the appliance supplied, so that the appliance can be isolated.

5.2.8 Electrical supplies for portable equipment

Cordless, battery-operated portable tools should be used if possible.

Mains-powered portable equipment (indoors or outdoors) should be supplied via a socket-outlet protected by a residual current device (RCD) (see **5.2.1**). The effectiveness of these devices should be verified frequently, using the test button, in accordance with the manufacturer's instructions.

NOTE Separated extra-low voltage (SELV) supplies incorporating a 110 V centre tapped transformer minimize the risk of serious electric shock. These systems provide a high level of protection in conditions such as in construction sites and heavy engineering workshops. The conditions in school and educational establishment workshops do not generally require this level of protection.

5.2.9 Socket-outlets for portable equipment

Socket-outlets of supplies with different voltages should not be compatible with outlets of other voltage systems.

For standard nominal 230 V a.c. supply with neutral at, or approximately at, earth potential, the socket-outlets should conform to BS 1363-2. Equipment that requires installation in a particular location or that requires an industrial type plug, should be supplied by socket-outlets conforming to BS EN 60309-2, colour coded blue.

For reduced low voltage, if used, socket-outlets should conform to BS EN 60309-2 and should be colour coded yellow.

Equipment that requires an electrical supply greater than 16 A and/or 250 V should be directly connected to fixed wiring.

Socket-outlets for use by caretaking employees only should conform to BS 1363-2. These socket-outlets should be protected by a residual current device and should be sited adjacent to an entrance door if possible. If it is essential to locate socket-outlets for caretaking employees in work areas, they should be supplied from an independent circuit (also protected by a residual current device), labelled "Cleaning use only" and activated by a removable key.

In new installations, surface mounted boxes for electrical accessories should not have multiple conduit knockouts. For socket-outlets or plugs, consideration should be given to fitting fixing screws that require a special tool for insertion and removal.

Socket-outlets with neon indicators should only be used to supply equipment for which an indication of an "on" condition is required (e.g. a refrigerator). Neon indicators should not be used to indicate that a socket-outlet is "off". Socket-outlets that supply voltages greater than extra-low voltage and up to 250 V (a.c. or d.c.) and that do not conform to BS 1363-2, BS 7288, BS EN 60309-2 or BS 546 (shuttered) should conform to BS 5733.

5.2.10 Plugs for portable equipment

Plugs for portable equipment should either conform to BS 1363-1 (i.e. should have sleeved pins) and should be fused either in accordance with the equipment manufacturer's instructions or in accordance with BS EN 60309-2, or conform to BS 546 (fused) or conform to BS 5733.

It is essential that plugs and socket-outlets used outdoors are provided with a degree of protection conforming to at least IP44 in accordance with BS EN 60529, or else conform to BS EN 60309-2.

NOTE In hose/wash-down areas a higher degree of protection might be required and the manufacturer's advice should be sought.

Only persons with sufficient technical knowledge and practical skills should fit plugs, to ensure that the manufacturer's instructions are carried out.

5.3 Mains gas installations

NOTE The Gas Act 1985, amended Gas Act 1995 and the Gas Safety (Installation and Use) Regulations 1998 (as amended) apply to gas installations. It is essential that all work on gas appliances is carried out by an HSE approved installer.

5.3.1 Main isolator

Emergency control valves should be situated as follows:

- as near as practicable to the point where the gas supply enters the building, either internally or externally;
- in a readily accessible position;
- so that the key or lever (handle) is parallel to the pipe when the valve is open and pulled down to close;
- with a test point fitted downstream of each valve.

NOTE The emergency control valve key or lever should be securely attached to the valve.

Emergency control valves should be clearly labelled.

5.3.2 Room isolation

Design and technology work areas with gas equipment should have a means of isolating the gas supply to the room. The means of isolation should be in a readily accessible position and should be clearly marked, but should not be readily accessible to students. The means of isolation should be either a manual valve, or a fail-safe electrically operated solenoid valve that may form part of an emergency stop system within the room.

5.3.3 Ventilation systems

Attention is drawn to the Gas Act 1985, amended Gas Act 1995 and the Gas Safety (Installation and Use) Regulations 1998 (as amended) regarding interlocked ventilation systems.

5.4 Fixed installations using liquefied petroleum gas

Liquefied petroleum gas (LPG) should be supplied by hard pipe from cylinders located outside the building in the open air. Cylinders should be securely fixed in an upright position with the valve uppermost. Manifold systems should incorporate a main shut-off valve and a regulator downstream (appropriately set), and a non-return valve downstream of these.

NOTE It is essential that all work on these appliances is carried out by an HSE approved installer.

LPG fired appliances should be fitted with appropriate safeguards (e.g. flame failure devices, shut-off valves, pilot burners).

5.5 Water installations

Hot and cold water should be provided to each work area and sinks should be fitted with bottle traps.

Waste pipes should be able to withstand corrosion from weak acid solutions.

It is essential that, in food technology areas, sinks are provided with hot and cold water, that the cold water is of drinking water quality and that there is a safe drinking water sign conforming to BS 5499-5 adjacent to the relevant tap.

5.6 Compressed air systems

NOTE 1 The Pressure Systems Safety Regulations 2000 apply to mobile and fixed compressed air systems.

Under the Pressure Systems Safety Regulations 2000, compressed air systems where the pressure multiplied by the internal volume of the pressure vessel exceeds 250 bar l have to have a "scheme of examination" drawn up by a competent person and the system has to be thoroughly examined by a competent person in accordance with the scheme.

NOTE 2 Preparation of a scheme of examination and performance of the examinations are normally contracted to insurance companies with specialist engineers.

Air receivers should conform to BS 5169. They should be tested hydraulically, and a certificate obtained from the manufacturer or a competent authority (e.g. an insurance company) stating the safe working pressure (SWP) of the receiver and details of the hydraulic tests. The SWP should be clearly marked on the receiver. Air receivers should be fitted with a suitable pressure gauge and safety valve, and an appliance for draining any condensate from the receiver. Air receivers should have an opening sufficiently sized to allow cleaning and thorough examination. If the receiver is designed so that the internal surface cannot be thoroughly examined, a suitable hydraulic test should be carried out instead. Water in the receiver should be drained at least once per week. Air receivers should be installed outside the work area if possible. If installed inside the work area, consideration should be given to the level of noise produced, and action taken as appropriate.

5.7 Machine installations

NOTE 1 The Provision and Use of Work Equipment Regulations 1998, Regulation 5, require that work equipment is suitable for the intended purpose and that it is located where risks to health and safety are minimized. The location should be chosen taking into consideration the location of other equipment, the purpose of the equipment, and the operating position (see also DfES Building Bulletin 81).

Machinery should be secured so that it cannot creep or be toppled. Floors should be level to prevent distortion of machines and should be checked for hidden services prior to drilling for fixings. Fixings for floors with surface finishes (wood block, tiles, vinyl sheeting, asphalt, etc.) should be long enough to penetrate the building structure or, where this is not possible, fixings appropriate to the particular surface finish should be used. Spring washers (or preferably lock nuts) should be used if the machine is liable to vibrate. Machines with a high centre of gravity should not be mounted on flexible mounts or glued felts. Glued felts and rubber composition pads should not be glued to a surface that is glued to the floor.

It is essential that benches that support machinery are level, secure, sufficiently strong, and at an appropriate height for safe operation of the equipment. Machines should be fixed securely to the bench if required. Equipment that does not require fixing (e.g. food processors, sewing machines) should be fitted with rubber feet to prevent slipping on the work surface.

NOTE 2 New machinery and equipment supplied since 1995 should have a CE mark affixed. This indicates that the machine has been designed and built in accordance with the essential safety requirements of the Supply of Machinery (Safety) Regulations 1992(as amended). These regulations are designed to provide a consistent and appropriate level of safety on new machinery. The regulations apply to the suppliers of equipment and are in addition to the duties of care that PUWER and MHSWR impose on users of equipment. CE regulations do not, in general, apply to used machinery, although PUWER does. However, teachers in schools should rely on their own risk assessment of proposed systems of work and hazards arising from the machine in the teaching environment.

5.8 Lifting equipment

The Lifting Operations and Lifting Equipment Regulations (LOLER)1998 apply to any equipment used for lifting and lowering loads (e.g. vehicle hoists, lifting beams, pulley blocks, engine cranes, jacks, chains, slings, eyebolts).

The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998 require the following:

- that all lifting operations are planned, supervised and carried out safely by competent persons;
- that lifting equipment is sufficiently strong, stable and suitable for purpose, and positioned or installed correctly to prevent risk of injury;
- that the safe working load is visibly marked on the equipment;
- that a test certificate is provided by the equipment supplier;
- that thorough examinations are carried out by a competent person at appropriate intervals. (These are normally every 12 months for lifting machines such as hoists/cranes and every six months for loose lifting equipment such as chains, slings, eyebolts, etc. Examinations are normally contracted to insurance companies with specialist engineers.)

Reports of examinations should be kept so that appropriate action can be taken as required.

Section 4: Teaching areas, equipment, tools and processes

6 General health and safety

There are a wide variety of specialist teaching environments in schools and colleges for design and technology, including engineering workshops, food technology rooms, electronics and control workshops, computer rooms, textiles rooms and design studios. Rooms where tools and equipment are used have varying degrees of risk for all users. It is essential that design and technology departments have clear health and safety guidance for using all teaching resources and environments. The guidance should include advice to teachers, technicians and students on safe use of specific equipment and safe organization of the teaching environment. It is essential that employees have at least a good understanding of equipment and processes, that they are confident in their use, and that they are fully aware of the risks involved and safety measures required to ensure safe working. Employees should be trained to the standards specified in the *Health and Safety Training Standards in Design and Technology*, published by the D & T Association. All health and safety training should be recorded and updated as part of professional good practice.

Students should be fully instructed in the use of equipment and processes before operating these. Students should be fully instructed in hazards associated with equipment and the precautions provided to counter these. It is essential that the teaching environment is appropriate for the task, that it is well maintained and that the level of supervision is appropriate for the level of risk. Close monitoring should be provided with high-risk operations. Tools and equipment should be well maintained, including regular sharpening of tools as appropriate. Hand held power tools usage should be closely monitored, especially if powered by mains electricity.

For work with students with special needs, learning difficulties of any kind or behavioural problems, or with students who do not have English as their first language, a specific risk assessment should be made. This might entail closer supervision, use of physical aids, provision of instructions in a second language, modified group sizes and/or special teaching programmes.

It is essential that power operated equipment and tools are isolated from the power source, and locked in the "off" position, in the following situations:

- when left unattended for any period of time;
- when the competent qualified person is not in the work area;
- before clearing out any blockage;
- before cleaning is carried out.

Power operated equipment and tools should be switched off in the following situations:

- before guards are adjusted or re-adjusted;
- before measuring or gauging is carried out;

- before tools are adjusted or changed;
- before coolant pipes are adjusted or re-adjusted;
- before removing chips or swarf.

Multi-purpose machines should not be used unless they are in accordance with the recommendations for the individual machines that they replace. Powered equipment and tools should only be used within the design working capacity, and accessories outside the recommended range of sizes should not be used.

7 Management of the teaching environment

7.1 General

Teachers should ensure that, following a thorough risk assessment, the following apply:

- the teaching environment is suitable for the class size;
- the class is orderly and properly managed;
- basic rules of care and maintenance are followed;
- safety checks and control measures are taught conscientiously and that students benefit from a good example.

Students should only work in a high-risk area when it is fully under the control of a person competent to work in the area (i.e. a person with demonstrated competency through the D & T Association/TDA training scheme) and, where appropriate, risk assessments have been carried out taking into account the students' capabilities. For specific higher risk activities, training and assessment of individual students is necessary and training records need to be kept. Care should be taken to ensure that risk assessments are carried out on the requirements of students with special needs.

If use of personal protective equipment is deemed necessary by risk assessment, and under the Personal Protective Equipment at Work Regulations 1992, this should be advised by clear signs in the area.

NOTE Attention is drawn to the Health and Safety (Safety Signs and Signals) Regulations 1996.

7.2 ICT workstations

For workstations used solely by students, it is considered good practice to comply with the minimum standards laid down in the Health and Safety (Display Screen Equipment) Regulations 1992 (see Note). It is recommended that workstations are capable of being adjusted to accommodate students of various sizes.

NOTE Information technology suites used by students are not covered by the Health and Safety (Display Screen Equipment) Regulations 1992. However, general duties under the Health and Safety At Work etc. Act 1974 in relation to persons who are not employed do apply. Any workstation used by a member of staff is required to meet the "minimum requirements" of the Health and Safety (Display Screen Equipment) Regulations 1992.

These are laid down in a schedule to the Regulations. Where a member of staff is a "user", a full risk assessment is required.

7.3 Maintenance

The Health and Safety at Work etc. Act 1974, Section 2, requires that employers ensure equipment is safe and that risks to health and safety are minimized. The Provision and Use of Work Equipment Regulations 1998 require that work equipment is maintained in efficient working order. A competent person should carry out repairs and maintenance of machines. It is essential that all repairs to gas equipment is carried out by an HSE approved gas engineer. It is essential that a regular maintenance programme is put into operation and that a maintenance log is kept. It is essential that all portable electrical equipment is visually examined before use to ensure that cables are not damaged or plugs loose, and that wires are not exposed. A competent person should carry out regular formal inspections and tests (if appropriate) to identify any faults that require repairs.

The frequency of formal inspections and tests should be chosen depending on the design, use and location of the equipment.

Hand tools should be regularly visually inspected to check the condition and, if appropriate, the sharpness.

7.4 Health and safety monitoring

Health and safety monitoring should be carried out regularly to ensure that:

a) emergency stop systems operate effectively;

b) room isolating gas taps or controls are clearly marked, accessible, and in working order;

c) only authorized competent persons use specialized equipment;

d) the power isolator is locked in the "off" position when the room is unsupervised;

e) equipment guards and protective interlocks are in place and properly adjusted;

f) health and safety notices are clearly displayed;

g) students receive appropriate health and safety instruction (and a record of their training is kept) before equipment is operated or before heavy items are lifted or handled;

h) suitable protective clothing is worn and personal protective equipment provided, where risk of injury cannot be controlled by other means;

i) first aid boxes are provided;

NOTE 1 Attention is drawn to the Health and Safety (First Aid) Regulations 1981 (see HSE Approved Code of Practice and Guidance L74).

j) floors, doors and gangways are kept clear and free from obstructions;

k) floor surfaces are not slippery;

l) fire doors are operational and clearly marked, can be easily opened, and are free from obstructions;

m) fire fighting equipment is readily available;

n) materials, tools and ancillary equipment are stored safely;

o) flammable materials are stored safely in a suitable lockable cupboard;

p) food products are stored at the correct temperature;

q) socket outlets, plugs and flexible cords are maintained in a safe condition, and are safely anchored by the cord grip;

r) fume and dust extraction systems are maintained in good working order;

NOTE 2 Attention is drawn to the Control of Substances Hazardous to Health Regulations 2002 (as amended) which require such systems to be thoroughly examined by a competent person at least once every 14 months and require records of test results to be kept.

s) gas hoses are maintained in a safe condition;

t) residual current devices are checked using the test button in accordance with the manufacturer's recommendations;

u) maintenance is carried out regularly and records kept.

8 Food and textiles – Appliances and equipment

8.1 General

8.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Electrical appliances and equipment can present a hazard of electric shock.

b) Trailing cables can present a tripping hazard.

c) Gas can cause an explosion.

d) Contact with cutters or blades can cause cuts.

e) Broken cutters and blades from cutting operations can be violently ejected if incorrectly fitted.

f) Inadvertent operation of appliances and equipment can present a hazard.

g) Appliances and equipment can present a noise hazard. (See **4.5**.)

h) Batteries can spontaneously combust or explode if incorrectly used.

8.1.2 Risk control measures

Appliances and equipment should be robust and single-purpose. Appliances and equipment should only be used for the design purpose in accordance with the manufacturer's recommendations. Equipment should conform to the appropriate standard.

Students should be aware of hazards associated with appliances and equipment and precautions that should be taken during use. Students should be assessed as competent before using the equipment, a record of their training should be kept and they should be supervised at all times by a trained, competent person. Personal protective equipment should be provided where appropriate.

If the appliance has exposed moving parts, long hair and loose clothing should be secured. Dangling jewellery should be removed.

Ear protection should be provided if required by the risk assessment.

Portable appliances and equipment should be kept in suitably locked storage when not in use.

Gas appliances should be turned off at the room main gas valve after use and checked before turning on the valve.

Portable appliances, equipment and supply leads should be visually examined before use.

A competent person should carry out inspections and tests (as appropriate) at least every 12 months, and records should be kept.

8.1.3 Portable electrical appliances and equipment

Battery powered portable electrical appliances should be used if possible. Batteries should be charged, fitted and disposed of in accordance with the manufacturer's instructions.

Portable electrical appliances should be single-purpose and robust. Portable electrical appliances should conform to the relevant part of BS EN 60335. Attachments should not be used. Wherever practicable, only double insulated mains fed portable electrical appliances and equipment should be used. A residual current device (RCD) should protect mains sockets (see **5.2.1**).

Portable electrical appliances and equipment should be fitted with the correct plug to match the socket outlet and correctly fused. It is essential that adapters are not used. The length of supply leads should be kept to a minimum to avoid tripping or accidental disconnection.

Portable electrical appliances should be included in a maintenance program in accordance with the manufacturer's recommendations.

8.1.4 Fixed electrical appliances

Refrigerators, freezers, washing machines, tumble dryers, and dishwashing machines should be installed by a competent person. Plugs and leads should be regularly inspected.

Fixed electrical appliances should be used in accordance with the manufacturer's instructions. A risk assessment should be carried out taking into account the users of the equipment. All fixed electrical appliances should be permanently wired into the electrical installation of the room by a competent person.

Socket-outlets supplying appliances pushed under a work-surface, e.g. dishwashers, tumble dryers and fridges should be accessible when the appliance is pulled out and should preferably be controlled by an accessible switch.

Appliances built into furniture (integrated appliances) should be connected to a socket-outlet or fused connection unit that is readily accessible when the appliance is in place and in normal use, or supplied from a socket-outlet or other connecting device controlled by a readily accessible double pole switch or switched fused connection unit.

8.2 Food – Appliances and equipment

8.2.1 Convection/fan assisted ovens

8.2.1.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) hot surfaces, which can cause burns;

c) steam from food being cooked, which can cause scalding.

8.2.1.2 Risk control measures

It is essential that convection/fan assisted ovens are correctly installed with an appropriately fused switch-disconnector**.**

An appropriate risk assessment should be carried out prior to using the oven and suitable personal protective equipment provided, e.g. oven gloves.

The equipment installed should be of a type where the external casing temperatures do not cause burns if touched.

To prevent scalding, care should be taken when opening the oven.

The oven should be kept clean and free from a build up of debris that could cause a fire.

The convection/fan assisted oven should be included in a planned maintenance programme that should include formal visual inspections and, where appropriate, tests that should be carried out by a competent person at suitable frequencies to identify any faults that require rectification to reduce risk. The frequency of these inspections and tests will depend on the design of the equipment and the type of use. One inspection every 12 months is recommended but experience may indicate this should be done more frequently or, in some cases, less frequently.

8.2.2 Tunnel ovens

8.2.2.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) hot surfaces, which can cause burns;

c) exposed moving parts, in which hair, hands or clothing can become entangled.

8.2.2.2 Risk control measures

Tunnel ovens should be correctly installed with an appropriately fused switch-disconnector.

An appropriate risk assessment should be carried out prior to using the oven and suitable personal protective equipment provided, e.g. oven gloves.

The equipment installed should be of a type where the external casing temperatures do not cause burns if touched.

The oven and conveyor should be kept clean and free from a build up of debris that could cause a fire.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed.

The tunnel oven should be included in a planned maintenance programme that should include formal visual inspections and, where appropriate, tests that should be carried out by a competent person at suitable frequencies to identify any faults that require rectification to reduce risk. The frequency of these inspections and tests will depend on the design of the equipment and the type of use. One inspection every 12 months is recommended but experience may indicate this should be done more frequently or, in some cases, less frequently.

8.2.3 Commercial range cookers

8.2.3.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) hot surfaces, which can cause burns;

c) cooking and combustion fumes;

d) steam and radiated heat, which can scald and burn.

8.2.3.2 Risk control measures

Range cookers should be correctly installed, with an appropriately fused switch-disconnector if the appliance's rating requires one, and an appropriately fitted gas connection, which might require an interlock with a ventilation extraction system, if fitted.

An appropriate risk assessment should be carried out prior to using the range cooker and suitable personal protective equipment provided, e.g. oven gloves.

The equipment installed should be of a type where the external casing temperatures do not cause burns if touched.

The oven should be kept clean and free from a build up of debris that could cause a fire.

Long hair and loose clothing should be secured so as not to come into contact with the appliance or any cooking utensils. Dangling jewellery should be removed.

The range cooker should be included in a planned maintenance programme that should include formal visual inspections and, where appropriate, tests that should be carried out by a competent person at suitable frequencies to identify any faults that require rectification to reduce risks. The frequency of these inspections and tests will depend on the design of the equipment and the type of use. One inspection every 12 months is recommended but experience may indicate this should be done more frequently or, in some cases, less frequently.

8.2.4 Domestic combination ovens (ovens with a hob)

8.2.4.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) hot surfaces, which can cause burns;

c) steam, which can cause scalding.

8.2.4.2 Risk control measures

Combination ovens should be correctly installed with an appropriately fused switch-disconnector.

An appropriate risk assessment should be carried out prior to using combination ovens and suitable personal protective equipment provided, e.g. oven gloves.

The equipment installed should be of a type where the external casing temperatures do not cause burns if touched. Students should be warned that hob surfaces, particularly those on ceramic hobs, remain hot for long periods after being switched off.

The oven should be kept clean and free from a build up of debris that could cause a fire.

Combination ovens should be included in a planned maintenance programme that should include formal visual inspections and, where appropriate, tests which should be carried out by a competent person at suitable frequencies to identify any faults that require rectification to reduce risk. The frequency of these inspections and tests will depend on the design of the equipment and the type of use. One inspection every 12 months is recommended but experience may indicate this should be done more frequently or, in some cases, less frequently.

8.2.5 Commercial blast chillers

8.2.5.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) bacterial growth.

8.2.5.2 Risk control measures

Blast chillers should be correctly installed with an appropriately fused switch-disconnector if hard wired or isolating plug and, if the appliance's rating requires one, with a ventilation extraction system.

The blast chiller should have a cleaning schedule in order to ensure that the chiller is kept clean internally.

There should be a monitoring procedure in place to check the operating temperatures.

The blast chiller should be included in a planned maintenance programme that should include formal visual inspections and, where appropriate, tests that should be carried out by a competent person at suitable frequencies to identify any faults that require maintenance to reduce the risk of incorrect operation. The frequency of these inspections and tests will depend on the design of the equipment and the type of use. One inspection every 12 months is recommended but experience may indicate this should be done more frequently or, in some cases, less frequently.

8.2.6 Fixed gas appliances

It is essential that installation and maintenance of fixed gas appliances are carried out by an HSE approved installer.

A chain should be fitted so that cookers cannot be pulled out of position and the flexible gas connection strained. Appliances should be regularly inspected and records kept.

Fixed gas appliances should be used in accordance with the manufacturer's instructions. A risk assessment should be undertaken covering the use of the appliance if it is considered that a significant risk is possible in its use in relation to those likely to use the equipment.

8.2.7 Portable food processing machines and liquidizers

8.2.7.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) rotating parts;

d) sharp cutters;

e) hot ingredients, which can cause scalding or burns.

8.2.7.2 Risk control measures

Portable food processing machines and liquidizers should be situated where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the food processing machine or liquidizer.

The machine should be checked to ensure that safety interlocks function correctly. The plug should be removed from the power socket before the machine is taken apart for any reason.

Students should be assessed as competent before using portable food processing machines or liquidizers. Instruction should be given on correct use of the food processing machine or liquidizer.

Long hair and loose clothing should be tied or secured well away from rotating parts. In industrial/commercial applications hair should be covered during food preparation.

The food processing machine or liquidizer should be checked to ensure it is correctly assembled before use.

Oven gloves should be used when handling hot food.

8.2.8 Portable food mixing machines

8.2.8.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) rotating parts;

d) sharp blades.

8.2.8.2 Risk control measures

Portable food mixing machines should be situated where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the food mixing machine.

The machine should be checked to ensure that any safety interlocks function correctly. The plug should be removed from the power socket before the machine is taken apart for any reason.

Students should be assessed as competent before using portable food mixing machines.

Long hair and loose clothing should be tied or secured well away from rotating parts. In industrial/commercial applications hair should be covered during food preparation.

The food mixing machine should be checked to make sure it is correctly assembled before use. Food mixing machines should be used as fixed units if practicable.

Instruction should be given on correct use of the food mixing machine. Additional instruction should be given on use of “hand-held” mixing machines (e.g. electric whisks).

8.2.9 Portable food blending machines

8.2.9.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) rotating parts;

d) sharp blades.

8.2.9.2 Risk control measures

Portable food blending machines should be used where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the machine itself.

The machine should be checked to ensure that any safety interlocks function correctly. The plug should be removed from the power socket before the machine is washed or taken apart for any reason.

Students should be assessed as competent before using portable food blending machines.

Long hair and loose clothing should be tied or secured well away from rotating parts. In industrial/commercial applications hair should be covered during food preparation.

The food blending machine should be checked to make sure that it is correctly assembled before use.

Instruction should be given on correct use of the food blending machine. It is important to keep the blender within a bowl or container whilst it is running or slowing down. The machine should not be turned on while the blender is outside of a container.

8.2.10 Microwave and microwave combination ovens

8.2.10.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) hot substances and hot surfaces, which can cause scalding and burns;

d) overheating of the oven mechanism, which can be caused by incorrect use of materials.

8.2.10.2 Risk control measures

Care should be taken to ensure that trailing leads are kept clear of work surfaces and persons using the oven.

Care should be taken to ensure that ingredients and materials are suitable for heating in the oven.

Oven gloves or cloths should be used when handling hot food.

Instruction should be given on correct use of the microwave or microwave combination oven.

8.2.11 Deep fat fryers and other table top cookers

8.2.11.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) hot substances and surfaces, which can cause scalding or burns;

d) a fire hazard from the hot fat or oil in deep fat fryers;

e) overheating, which can be caused by other table top cookers;

f) environmental hazards, which can be caused by incorrect disposal of fat or oil.

8.2.11.2 Risk control measures

Care should be taken to ensure that trailing leads are kept clear of work surfaces and persons using the fryer or cooker.

Care should be taken to ensure that ingredients and materials are suitable for heating in the deep fat fryer or other table top cooker.

Excess moisture should be removed from ingredients before cooking.

Oven gloves or cloths should be used when handling hot food.

Instruction should be given on correct use of the deep fat fryer or other table top cooker.

Fats and oils should be changed regularly. Attention is drawn to local authority procedures for disposal.

8.2.12 Pressure cookers

8.2.12.1 Hazards

Employees and students should be aware of the following hazards:

a) hot substances and surfaces, which can cause scalding or burns;

b) the high temperatures at which pressure cookers operate;

c) high pressures, which can cause a pressure cooker to explode.

8.2.12.2 Risk control measures

Care should be taken to ensure that ingredients and materials are suitable for heating in the type of pressure cooker used. Care should be taken to ensure that there is sufficient water in the pressure cooker.

Oven gloves or cloths should be used when handling hot food.

Instruction should be given on correct use of pressure cookers.

NOTE 1 Pressure cookers are covered by the Pressure Systems Safety Regulations 2000.

A scheme of examination should be prepared and carried out for pressure cookers.

NOTE 2 CLEAPSS has produced a model scheme of examination for pressure cookers that conforms to the Pressure Systems Safety Regulations 2000. Under the scheme, examinations can be carried out by a competent employee at the school or similar establishment.

8.3 Textiles – Appliances and equipment

8.3.1 Batik wax pots

8.3.1.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which can be tripped over;

c) hot liquids and surfaces, which can cause scalding or burns;

d) overheating of the wax pot, which can be caused by incorrect use.

8.3.1.2 Risk control measures

Batik work should be carried out where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the wax pot. Supply leads for wax pots should be heat resisting.

Care should be taken to ensure that materials are suitable for heating in the type of heater used.

Gloves should be worn when handling hot wax.

Instruction should be given on correct use of wax pots.

8.3.2 Portable electric irons (including heat presses)

8.3.2.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which can be tripped over;

c) the hot surface of the iron, and steam from a steam iron, which can cause burns and scalds;

d) hazards from falling irons.

8.3.2.2 Risk control measures

Ironing should be carried out where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the hot iron. Supply leads for irons should be heat resisting.

Irons should be stored and used where they are not likely to fall.

Instruction should be given on correct use of irons.

8.3.3 Portable sewing/overlocking/embroidery/embellisher machines

8.3.3.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) rotating parts;

d) exposed sharp edges and needles;

e) unexpected starting, in the case of computer numerically controlled (CNC) machines.

8.3.3.2 Risk control measures

Sewing/overlocking/embroidery/embellisher machines should be situated where distractions to the user can be minimized.

Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the sewing machine.

Students should be assessed as competent before using portable sewing/overlocking/embroidery/embellisher machines.

Long hair and loose clothing should be tied or secured well away from rotating parts.

Instruction should be given on correct use of sewing/overlocking/ embroidery/embellisher machines.

Machines should be included in a planned maintenance programme that should include electrical safety tests.

9 Portable tools and equipment used in workshops

9.1 General

9.1.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) cutters, blades, abrasive wheels and sanding discs, contact with which can cause injuries;

c) broken cutters, blades and abrasive wheels, and particles from cutting operations, which can be violently ejected;

d) trailing cables and compressed air lines, which could be tripped over;

e) contact with the open end of a compressed air line, which can force air through the skin into the bloodstream;

f) unrestrained compressed air lines, which can lash about with force;

g) inadvertent operation of portable tools;

h) dust, which can be inhaled;

i) noise;

j) batteries, which can spontaneously combust or explode if incorrectly used;

k) start-up torque.

9.1.2 Risk control measures

Portable tools should be single-purpose and robust.

Portable tools should only be used for the design purpose in accordance with the manufacturer's recommendations. Tools should conform to the appropriate standard.

Students should be aware of hazards associated with portable tools and precautions that should be taken during use. Before using the equipment, students should be trained and assessed as competent, and a record of their competence should be kept. Students should be physically capable of using portable tools, and supervised at all times by a trained, competent person. Personal protective equipment should be used.

Portable tools should be immobilized when changing cutters, blades, etc.

If the machine has moving parts or is likely to produce hazardous material, long hair and loose clothing should be secured. Dangling jewellery should be removed. Gloves should not be worn. Suitable eye protection should be used.

A risk assessment on dust should be carried out, and local exhaust ventilation or respiratory protective equipment provided if required. A risk assessment on noise levels should be carried out. Ear protection should be provided if required.

Portable tools should be securely and appropriately stored when not in use. Portable tools and supply leads or hoses should be visually examined before use. A competent person should carry out inspections and tests (as appropriate) at least every 12 months and records of inspections and test results should be kept.

9.1.3 Risk control measures specific to portable compressed air tools and equipment

Compressed air powered tools should be operated at the manufacturer's recommended pressure. A regulator and pressure gauge should be fitted between the equipment and the permanent supply.

The length of the air hose should be kept to a minimum. The air hose should be able to withstand the safe working pressure. Compressed air hose fittings should automatically cut off the air supply when disconnected. Fittings should be regularly checked to ensure they are securely attached to the hose.

Tools and equipment with an air piston should have a lubricator on the tool side of the regulator.

Compressed air lines with guns (jets) fitted should have a non-ferrous venturi-type nozzle.

WARNING. Care should be taken when using compressed air guns, as air accidentally forced into the bloodstream can be life threatening. Care should be taken to avoid projecting debris into the eyes. It is essential that suitable eye protection is used. Non-users of compressed air guns should not be allowed near the equipment.

Connections on flexible compressed air lines should be checked regularly. Compressed air equipment should not be used for cleaning down purposes or for removal of dust from brakes or machines unless specifically designed for this purpose.

9.1.4 Risk control measures specific to portable electric tools and equipment

Portable electric tools should be single-purpose and robust. Portable electric tools should conform to BS 2769. Attachments should not be used. Only double insulated mains fed portable electric tools should be used. A residual current device (RCD) should protect mains sockets (see **5.2.1**).

Portable electric tools should be fitted with the correct plug to match the socket outlet and correctly fused. It is essential that adapters are not used. The length of supply leads should be kept to a minimum to avoid tripping or accidental disconnection.

Battery powered portable electric tools should be used if possible. Batteries should be charged, fitted and disposed of in accordance with the manufacturer's instructions.

Soldering irons and handlamps of extra-low voltage (below 50 V a.c.) type should be used if practicable.

9.2 Portable drills

9.2.1 Hazards

Employees and students should be aware of the following hazards:

a) long hair, loose clothing, etc., which can become entangled in moving parts of the drill;

b) chuck keys, broken drill bits, swarf, work pieces, etc., which can be violently ejected;

c) sharp edges on drill bits, work pieces and swarf, which can cause cuts;

d) electric shock;

e) leads and hoses, which could be tripped over;

f) drill jamming, which can produce a torque reaction;

g) dust, which can be inhaled;

h) ejected particles.

9.2.2 Risk control measures

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator or others in the vicinity or the drill. It should be ascertained whether the operator has sufficient strength to withstand the turning moment of the drill if the drill bit becomes jammed.

Long hair and loose clothing should be tied or otherwise secured away from rotating drill parts. Suitable eye protection should be used.

Instruction should be given to ensure that users do not touch rotating parts of the drill. The chuck key should only be used to tighten and loosen the chuck, and otherwise kept safely away from the drill. Training should be given on deburring sharp edges on drilled materials.

9.3 Portable grinders (e.g. angle grinders)

WARNING. Students may only use portable grinders when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.3.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) overspeeding, damaged or incorrectly mounted abrasive wheels, which can break while rotating and can be violently ejected from the grinder;

d) contact with the wheel, which can cause cuts;

e) long hair, loose clothing, etc., which can become entangled with the spindle or wheel;

f) ejection of work pieces from the machine;

g) hot work pieces, which can cause burns;

h) sharp edges, which can cause cuts;

i) inadvertent starting of the machine;

j) dust, which can be inhaled;

k) incorrect disc.

9.3.2 Risk control measures

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator or others in the vicinity of the grinder.

Long hair and loose clothing should be tied or secured away from rotating parts. Suitable eye protection should be used. Consideration should be given to wearing gloves to protect the operator from hot material. The grinding or cutting disc should have a safe working speed that exceeds the machine speed.

The grinding or cutting disc should be inspected for damage prior to each use and changed accordingly. The disc should be securely fitted to the machine.

The composition of the disc should suit the material of the work piece being ground.

Instruction should be given to ensure that users do not touch rotating parts of the grinder. A suitable guard should be fitted. Non-users of the grinder, and objects that could be damaged by ejected material or sparks, should be kept well away from the grinder.

NOTE For recommendations on the use of abrasive wheels see ***11.5****.*

Grinders should be used in accordance with the recommendations of HSG 17, *Safety in the Use of Abrasive Wheels*, and in accordance with the manufacturer's instructions.

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

9.4 Rotating (circular) portable saws

WARNING. Students may only use rotating (circular) portable saws when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.4.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) rotating parts, which can cause cuts and with which long hair, loose clothing, etc., can become entangled;

d) dust, which can be inhaled;

e) ejected particles;

f) jamming or "kick back" of the saw.

9.4.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if practicable. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the portable saw.

The peripheral speed of the saw blade should match the speed of the machine. The blade should be securely fitted to the machine. The blade should be inspected for damage prior to each use. Damaged blades should not be used.

Students should be assessed as competent before using rotating portable saws. Rotating portable saws should only be used under supervision from a competent person specifically trained in the use of the saw.

Long hair and loose clothing should be tied or otherwise secured away from rotating parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch the rotating parts of the saw. The saw should have the correct guard fitted. Rotating portable saws should not be used if the operator could be distracted. Non-users of the saw, and objects that could be damaged by ejected material, should be kept well away from the saw. The user should be sufficiently strong to withstand any "kick back" that could occur.

9.5 Portable biscuit cutters

WARNING. Students may only use biscuit cutters when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.5.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) rotating parts which can cause cuts and with which long hair, loose clothing, etc., can become entangled;

d) dust, which can be inhaled;

e) ejected particles;

f) jamming or "kick back" of the biscuit cutter.

9.5.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if practicable. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the portable biscuit cutter.

The peripheral speed of the saw blade should match the speed of the machine. The blade should be securely fitted to the machine. The blade should be inspected for damage prior to each use. Damaged blades should not be used.

Students should be assessed as competent before using portable biscuit cutters, which should only be used under supervision from a competent person specifically trained in the use of the equipment.

Long hair and loose clothing should be tied or otherwise secured away from rotating parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch the rotating parts of the biscuit cutter. The machine should have the correct guard fitted. Portable biscuit cutters should not be used if the operator could be distracted. Non-users of the machine, and objects that could be damaged by ejected material, should be kept well away. The user should be sufficiently strong to withstand any "kick back" that could occur.

9.6 Reciprocating portable saws (e.g. jig saws)

WARNING. Students may only use reciprocating portable saws when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.6.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) reciprocating parts;

d) dust, which can be inhaled;

e) ejected particles;

f) jamming or "kick back" of the saw.

9.6.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if practicable. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the saw.

The blade should be securely fitted to the machine and should only be used on materials specified by the manufacturer. The blade should be inspected for damage prior to each use. Damaged blades should not be used.

Students should be assessed as competent before using reciprocating portable saws. Reciprocating portable saws should only be used under supervision from a competent person specifically trained in the use of the saw.

Long hair and loose clothing should be tied or otherwise secured away from moving parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch the moving parts of the saw. The saw should have the correct guard fitted. Reciprocating portable saws should not be used if the operator could be distracted. Non-users of the saw, and objects that could be damaged by ejected material, should be kept well away from the saw. The user should be sufficiently strong to withstand any "kick back" that could occur.

9.7 Portable sanding machines (orbital)

9.7.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) moving parts;

d) dust, which can be inhaled.

9.7.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the sanding machine.

Long hair and loose clothing should be tied or otherwise secured away from moving parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch moving parts of the portable sanding machine and that the abrasive medium is firmly attached to the machine.

9.8 Portable sanding machines (disc)

9.8.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) moving parts;

d) jamming of the sanding disc;

e) dust, which can be inhaled.

9.8.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the sanding machine.

Long hair and loose clothing should be tied or otherwise secured away from moving parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch moving parts of the portable sanding machine and that the abrasive medium is firmly attached to the machine.

The operator should have sufficient strength to withstand the turning moment of the sanding disc if the disc becomes jammed.

9.9 Portable sanding machines (belt)

9.9.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) moving parts;.

d) the pulling force that can be exerted by the belt of the machine;

e) jamming of the sanding belt;

f) dust, which can be inhaled.

9.9.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the sanding machine.

Long hair and loose clothing should be tied or otherwise secured away from moving parts. Suitable eye protection should be used.

Instruction should be given to ensure that users do not touch moving parts of the portable sanding machine and that the abrasive medium is firmly attached to the machine. The belt should be fitted so that the arrow on the back matches the direction of rotation of the machine. The tracking of the belt should be adjusted correctly.

The operator should have sufficient strength to withstand the pulling motion of the sanding belt if the belt becomes jammed.

9.10 Portable planing machines

WARNING. Students may only use portable planing machines when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.10.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which can be tripped over;

c) rotating parts;

d) dust, which can be inhaled;

e) jamming or “kick back” of the machine.

9.10.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the planer.

The planer blades should be inspected for damage. Damaged blades should not be used. The blades should be securely fitted to the machine in accordance with the manufacturer’s instructions.

Students should be assessed as competent before using portable planing machines. Portable planing machines should only be used under supervision from a competent person specifically trained in the use of the machine.

Long hair and loose clothing should be tied or secured well away from rotating parts. Suitable eye protection should be worn.

Instruction should be given to ensure that users do not touch rotating parts of the portable planing machine. The machine should have the correct guard fitted.

Portable planing machines should not be used if the operator could be distracted. Non-users of the machine, and objects that could be damaged by ejected material, should be kept well away from the machine. The user should be sufficiently strong to withstand any "kick back" that could occur.

Portable planing machines should not be turned over and fitted to a bench for use as overhand planers.

9.11 Portable routers

WARNING. Students may only use portable routers when they have been assessed and the assessment has shown that they are competent, and they are under the appropriate supervision of specifically trained staff.

9.11.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads and hoses, which could be tripped over;

c) rotating parts;

d) dust, which could be inhaled;

e) ejected particles;

f) jamming, "kicking back" or biting in of the router cutter;

g) distraction of the user.

9.11.2 Risk control measures

A risk assessment on dust inhalation should be carried out and local exhaust ventilation provided if required. Respiratory protective equipment should be worn if appropriate.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator or the cutter.

The peripheral speed of the router cutter should match the speed of the machine. The router cutter should be inspected for damage. A damaged cutter should not be used. The cutter should be securely fitted to the machine in accordance with the manufacturer's instructions.

Instruction should be given to ensure that users do not touch the rotating parts of the tool. The tool should have the correct guard and/or fence fitted.

Instruction should be given to ensure that routing operations are undertaken well away from persons and objects that could be affected by material being ejected from the operation. The person using the machine should be sufficiently strong to withstand any kicking back or biting in that might take place when the router is in use.

Suitable eye protection should be worn when using a portable router.

A local exhaust ventilation unit should be used to control the dust hazard where the risk assessment of the operation indicates a significant risk. Those persons particularly susceptible to dust irritation, and all users if sustained routing is undertaken, should use an appropriate dust mask.

Long hair and loose clothing should be tied or secured well away from rotating parts.

A portable routing machine may be turned over and fitted to a proprietary purpose-made table to act as a small spindle-moulding machine using one-piece cutters. In this mode of working the portable router may only be used by a member of staff, who should be a competent person specifically trained in its use and holding a certificate to that effect issued by an appropriate body, usually the employer. It is essential that the cutter is guarded at all times when in use.

A portable router should not be used when there is a likelihood of the operator being distracted when using the tool.

9.12 Soldering irons

9.12.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which can be tripped over;

c) fumes from rosin based fluxes, which can cause respiratory sensitization;

d) hot soldering iron tips, which can cause burns;

e) splashes of flux and solder.

9.12.2 Risk control measures

Extra-low voltage soldering irons are preferred if practicable.

Non-rosin based fluxes should be used where practicable. Where rosin based fluxes have to be used, a risk assessment on fume inhalation should be carried out and local exhaust ventilation provided as required.

Supply leads for soldering irons should be heat resisting. Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the hot soldering iron.

Instruction should be given on correct use of the soldering iron.

Soldering should be carried out where distractions to the user can be minimized.

Suitable eye protection should be worn.

9.13 Hot melt glue guns

9.13.1 Hazards

Employees and students should be aware of the following hazards:

a) electric shock;

b) leads, which could be tripped over;

c) hot glue nozzle tips, which can cause burns;

d) splashes of glue, which can cause burns.

9.13.2 Risk control measures

Supply leads for glue guns should be heat resisting. Care should be taken to ensure that trailing leads do not become entangled with the operator, others in the vicinity or the hot glue nozzle.

Instruction should be given on correct use of the glue gun including warning students of the hot surfaces of the gun and the risk of burns from the residual heat of any molten glue that comes into contact with the skin.

Suitable eye protection should be worn.

Where possible, low melting point glue guns should be used, but in certain situations where a higher temperature is required for satisfactory gluing, standard hot melt glue guns may be used.

Consideration should be given to providing the glue gun with an appropriate stand to ensure that hot glue that dribbles from the nozzle when the glue gun is switched on but not in use does not result in a glue build up on a surface under the gun that could easily be touched by students.

9.14 Hand tools

9.14.1 Hazards

Employees and students should be aware of the following hazards:

a) sharp tools;

b) falling tools;

c) tools breaking or coming apart in use;

d) slipping of tools, which can occur when pressure is applied to them.

9.14.2 Risk control measures

Hand tools should be stored at a suitable height for access. Hand tools should not be left projecting from a bench.

The faces of hammer heads and hammer shafts should be frequently inspected. Damaged heads and shafts should be discarded. It is essential that the correct handle is securely fixed on the tool. Wedges in hammer shafts should be kept tight.

"Mushrooming" on the struck ends of metalworking chisels should be removed regularly.

Edged tools should be kept sharp and in good condition.

Sawing boards (bench hooks) should be maintained in good condition.

Instruction should be given on correct use of hand tools.

Sharp or pointed tools should be handled with care (with cutting edges protected or pointing downwards).

Tools should not be carried in pockets or under belts.

The correct size of spanner should be used to fit nuts and bolts. Packing pieces should not be used.

10 Woodworking machinery

10.1 General

NOTE 1 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended) require employers to prevent, or to adequately control, exposure by inhalation to wood dust. Dust from all types of wood, hardwood, softwood and composite materials such as medium density fibreboard (MDF) has been assigned a workplace exposure limit (WEL) of 5 mg·m^{-3}. This is a time weighted average over an eight hour period. For both hardwood and softwood dusts the COSHH Regulations require employers to ensure that exposure by inhalation is reduced as far as reasonably practicable and in any case to below the WEL.

A risk assessment should be carried out on woodworking machinery to evaluate risks to health and any action required to prevent or control risks. This should involve consideration of the dust concentrations inhaled and the length of time exposed. Machining operations such as sawing, turning and routing produce coarse dust that tends to drop to the floor. Sanding operations generate fine dust that remains airborne and is easily inhaled. Higher dust concentrations are produced from MDF than from hardwoods or softwoods.

Where reasonably practicable, control of exposure by inhalation should be achieved by means other than by respiratory protective equipment (RPE) [e.g. using systems of work and engineering controls such as local exhaust ventilation (LEV) systems and good general ventilation].

LEV systems should be thoroughly examined at least every 14 months by a competent person. (Examinations are normally contracted to insurance companies or to LEV suppliers who employ specialist engineers.) In addition to thorough examinations, an employee should carry out a weekly check to verify that the basic operational features are functioning correctly.

Where engineering measures to reduce exposure by inhalation are not adequate, RPE should be used. The type of RPE should depend on the likely dust concentrations, but disposable filtering respirators conforming to BS EN 149:2001, Class FFP2 can be expected to provide adequate protection. Training should be provided on correct use of respirators. Disposable filtering respirators should be replaced as appropriate in accordance with the manufacturer's instructions.

NOTE 2 Wood responds unevenly to internal stresses. This can result in unpredictable bending and breaking when working with the material.

NOTE 3 The Management of Health and Safety at Work Regulations 1999 and the Provision and Use of Work Equipment Regulations 1998 require employers to provide sufficient training so that persons are able to control risks. Training is required before new or increased risks are encountered. Training should be repeated if required to maintain competence. The Approved Code of Practice and Guidance on Safe Use of Woodworking Machinery (L114) issued by the HSE under the PUWER 1998 provides more detailed information on training.

The school or similar establishment should decide which machinery is suitable for use by each group of students. The decision should be based on student maturity and competence, the level of supervision, and local authority/employer and national guidelines. In general:

a) students should be trained and instructed in safe operating methods by a competent person, who has attended a recognized training course;

b) students should be assessed as mature and competent before operating the machinery, and should be continuously supervised.

Where young persons (persons under 18) are employed or participating in a work experience scheme, employers are required to assess the risks to which young persons are exposed and to implement measures to protect their health and safety (see **2.1**). Young persons should not use high-risk woodworking machinery unless they have been assessed as mature and competent and have received sufficient training, and a record of their training has been kept. Training in the use of high-risk woodworking machinery should only be provided under proper supervision.

NOTE 4 "High-risk woodworking machinery" includes any hand-fed woodworking machinery, any sawing machine fitted with a circular blade or saw band, and planing machines when used for surfacing.

Electrical hazards from woodworking machinery should be minimized by ensuring that electrical equipment conforms to BS EN 60204-1 unless otherwise stated (see **5.2.6**).

Employees should be competent and properly trained to the standards specified in the D & T Association publication *Health and Safety Training Standards in Design and Technology*.

It is essential to ensure that the following general safety measures are applied when working with woodworking machinery.

- Guards and fences should be securely fitted and correctly set. They should be appropriate for the machine and the activity.
- Tooling should be of the correct type, size, sharpness, and direction of cut, and securely fastened.
- Woodwork machinery should be used at the correct speed.
- Loose clothing should not be worn. Jewellery should be removed.
- Suitable eye protection should be worn.
- Ventilation/extraction equipment should be properly adjusted and working.

*NOTE 5 For CNC machining centres see **16.4**.*

10.2 Mortising machines (hollow chisel type)

NOTE Chain mortisers are not suitable for school use.

10.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Work pieces in the mortising machine can become loose and can be ejected.

b) Hands or clothing can become entangled with the cutting tool.

c) Inadvertent starting of the machine can present a hazard.

d) Wood dust can be inhaled.

10.2.2 Risk control measures

It is essential that the mortising machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

A risk assessment should be carried out to evaluate the risks to health from inhalation of wood dust and any action required to prevent or control the risks (see **10.1**).

Care should be taken to ensure that the timber work piece is securely clamped.

The key for locking the bit in the chuck should be removed before starting the machine and after the work is completed.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.3 Moulding machines (spindle moulders)

Moulding machines should not be used in schools and sixth form colleges.

*NOTE The nature of the built-up cutter and the difficulty of guarding the machine adequately for short non-production runs is too high a risk for schools, except as in **9.11**. Colleges of further education may wish to undertake their own risk assessments to enable these machines to be used.*

10.4 Planing and thicknessing machines

*NOTE 1 Planing and thicknessing machines are "high-risk woodworking machinery" (see **10.1**).*

NOTE 2 All planing and thicknessing machines are now required to have a number of enhanced safety features such as a braked motor.

NOTE 3 The HSE Approved Code of Practice and Guidance on the Safe Use of Woodworking Machinery (L114) issued under the PUWER 1998, requires that existing planing and thicknessing machines have a braking device providing a run down time of less than 10 s.

WARNING. Students in schools and sixth form colleges should not use planing and thicknessing machines.

10.4.1 Hazards

Operators should be aware of the following hazards.

a) The work piece in planing and thicknessing machines can be "kicked back" towards the operator.

b) Hands or clothing can become entangled with the cutting tool.

c) Inadvertent starting of the machine can present a hazard.

d) Noise can cause permanent hearing damage.

e) Wood dust can be inhaled.

10.4.2 Risk control measures

It is essential that planing and thicknessing machines are provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

The upper part of the machine, including the infeed and outfeed rollers, should be guarded to prevent accidental access to the cutter block and feed rollers. An anti-kick back device should be fitted over the whole working width of the machine. The width of the anti-kick back fingers should be between 3 mm and 8 mm for machines with a useful working width less than 260 mm and between 8 mm and 15 mm for machines with a useful working width 260 mm and above.

NOTE 1 The risk of ejection of thin work pieces when they come into contact with the cutters can be reduced by using sectional feed rollers. Feed roller sections should not exceed 50 mm in width.

It should be possible to lock the machine "off" when not in use.

Planing and thicknessing machines together with their LEV system can produce noise levels of about 100 db(A). A competent person should carry out an assessment of the daily personal exposures. Ear defenders are likely to be necessary if the machines are used for more than a few minutes.

NOTE 2 Any person exposed to this level of noise for more than a few minutes each day needs to be protected by actions at the first or the second action level specified in the Control of Noise at Work Regulations 2005 (see ***4.5****).*

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust and any action required to prevent or control the risks (see **10.1**).

Only competent and trained persons should use planing and thicknessing machines.

NOTE 3 Users should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D & T Association.*

Planing and thicknessing machines should not be used if the user could be distracted.

The radial cutting edge of the tool should not project from the block by more than 1.1 mm. Care should be taken that knives are secure and correctly set. Tools should be clearly and permanently marked with the following information:

- the name or trademark of the manufacturer or supplier;
- "man." if manual (i.e. hand fed);
- the minimum clamping length and corresponding blade thickness.

A "push stick" should be used to push short work pieces into the machine.

For surface planing, an adjustable bridge guard with the following characteristics should be provided.

- The bridge guard should be lockable in any position without using a tool.
- The height of the bridge guard should be adjustable from 0 mm to 75 mm above the outfeed table. (Height adjustment should be continuous, not in steps.)
- The width of the bridge guard should be 100 mm for cutter blocks up to and including 350 mm, and 120 mm for cutter blocks over 350 mm.
- The edge of the bridge guard should be set as close as possible from the upper surface of the work piece on the infeed table side, and no more than 3 mm away on the outfeed side.

For thicknessing, a guard that does not impede discharge of the waste should be fitted to prevent access to the cutter block.

The planing and thicknessing machine should be included in a planned maintenance programme that should include electrical safety tests.

10.5 Sanding machines (belt, bobbin and disc types)

*NOTE Sanding machines are "high-risk woodworking machinery" (see **10.1**).*

10.5.1 Belt/band facer and bobbin sanding machines

10.5.1.1 Hazards

Employees and students should be aware of the following hazards.

a) The work piece can become jammed in the sanding machine.

b) Hands or clothing can become entangled with moving parts.

c) Wood dust can be inhaled.

d) Inadvertent starting of the machine can present a hazard.

e) The belt can break up and lash out.

f) Hands can come into contact with the abrasive surface.

10.5.1.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

The belt should be narrower than the belt support plate and pulleys, to protect the user from the belt edges. It is essential that belts are set in the correct direction of rotation.

The sanding table on vertical sanding machines should be of rigid metal construction. The gap between the table and the belt should be sufficient to clear the debris but small enough to ensure sufficient support for the timber. For angled sanding, it should only be possible to tilt the table downwards away from the belt, to avoid jamming timber between the table and the belt.

On horizontal sanding machines the fence should be correctly set, close to the abrasive surface. The tracking should be checked by rotating first by hand.

On bobbin sanding machines, there should be as small a gap as possible between the table insert and the bobbin.

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust and any action required to prevent or control the risks (see **10.1**).

Suitable eye protection should be used if deemed appropriate by the risk assessment. Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Abrasive belts and bobbins should be examined before use. Torn belts and bobbins should be discarded.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.5.2 Disc sanding machines

10.5.2.1 Hazards

Employees and students should be aware of the following hazards.

a) The work piece can become jammed in the sanding machine.

b) Hands or clothing can become entangled with the sanding disc, or caught between the disc and work piece support.

c) Wood dust can be inhaled.

d) Inadvertent starting of the machine can present a hazard.

e) The sanding disc can break up during use.

10.5.2.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms (only the down-running quadrant of the sanding disc should be exposed).

The sanding table should be of rigid metal construction. The gap between the table and the disc should be sufficient to clear the debris but small enough to ensure sufficient support for the timber. The table should be positioned so that sanding only occurs from downward movement of the disc face. Small pieces of timber should not be disc sanded. The teacher or responsible person should check the setting of the machine before use.

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust, and any action required to prevent or control the risks (see **10.1**).

Suitable eye protection should be used if deemed appropriate the by risk assessment. Long hair should be protected from entanglement.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.6 Sawing machines (band, circular and reciprocating saws)

NOTE 1 All sawing machines are now required to have a number of enhanced safety features such as a braked motor.

NOTE 2 The HSE Approved Code of Practice and Guidance on the Safe Use of Woodworking Machinery (L114) issued under the PUWER 1998, requires that existing sawing machines include a braking device providing a run down time of less than 10 s.

10.6.1 Band sawing machines

*NOTE Band sawing machines are "high-risk woodworking machinery" (see **10.1**).*

WARNING. Students may only use band saws when they have been assessed and the assessment has shown that they are competent, and they are under the direct supervision of specifically trained staff.

10.6.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Work pieces can become jammed in band sawing machines.

b) Bench mounted band saws can become detached from the bench.

c) Hands or fingers can come into contact with the blade.

d) Clothing can become entangled with the blade.

e) Wood dust can be inhaled.

f) Noise can cause permanent hearing damage.

g) Inadvertent starting of the machine can present a hazard.

h) Withdrawing the work piece with the machine running can present a hazard.

i) Blunt or damaged blades can present a hazard.

10.6.1.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency.

It should be possible to lock to "off" whenever the machine is not in use, if a locking device is not incorporated in the machine itself.

Band saws should be checked to ensure they are secure. It is essential that bench mounted models are effectively fixed to the bench.

The pulley wheels and blade (except for the down-running part through the machine table) should be completely enclosed by the frame of the machine and/or fixed guards (removable only with the use of a tool), or alternatively interlocked guards. A guard that can be adjusted to suit the height of the work piece should protect the part of the blade not used for cutting. The guard should be connected to, and moved with, the upper blade guide.

Students should only be trained to use band sawing machines by a competent and trained person. A record of their training should be kept.

NOTE The trained person should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D & T Association.*

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust, and any action required to prevent or control the risks (see **10.1**).

Suitable eye protection should be used if deemed appropriate the by risk assessment. Long hair should be protected from entanglement.

Saw blades should be of the correct pattern, sharp and distortion-free. (Blunt or distorted blades can break if used.) Saw blades should conform to BS 4411. It is essential that the saw blade has the full number of teeth, as missing teeth can cause timber to "kick back". The saw blade should be checked for correct tension and tracking before use. If a machine is fitted with a brake, it should be used with care.

The top and bottom guides, if not aligned properly, can cause damage to the blade. The top guide should be adjusted to the lowest possible position and the part of the blade above it properly guarded.

The guide blocks and table should be maintained in good condition.

It is essential to ensure that users keep their fingers clear of the saw line and do not make adjustments to the machine set-up until it stops. Care should be taken when withdrawing the work piece while the machine is in operation (e.g. after making a long curving cut, when friction between the blade and the work piece can pull the blade off the guides and pulley). Care should be taken not to make a curving cut with too small a radius in relation to the blade width and tooth size.

Bench mounted band sawing machines should be checked to ensure they are securely fixed to the bench before use.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.6.2 Table circular sawing machines

*NOTE Circular sawing machines are "high-risk woodworking machinery" (see **10.1**).*

WARNING. Students in schools and sixth form colleges should not use circular sawing machines.

10.6.2.1 Hazards

Operators should be aware of the following hazards.

a) The work piece can become jammed in the circular sawing machine or can "kick back".

b) Hands or fingers can come into contact with the blade.

c) Wood dust can be inhaled.

d) Noise can cause permanent hearing damage.

e) Inadvertent starting of the machine can present a hazard.

f) Blunt or damaged blades can present a hazard.

10.6.2.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

It should be possible to lock the machine to "off" when not in use, if a locking device is not incorporated in the machine.

There should be sufficient space around the saw bench so that the timber can be handled safely. The floor of the work area should be level. The floor surface should be kept free from loose material and should be non-slippery.

Projecting ends of saw spindles should be guarded. The part of the blade below the machine table should be guarded by the main frame of the machine, or, for open frame machines, by a fixed guard that requires a tool for removal.

The riving knife should be securely fixed below the surface of the table and should be set so that the gap between the knife and the saw blade at table level is the minimum practicable, and at any rate not exceeding 8 mm and not less than 3 mm. The riving knife should be thicker than the plate of the saw, but thinner than the saw kerf. The riving knife should extend upwards from the table surface to a point not more than 25 mm below the top of the saw blade, or to a minimum height of 225 mm if the diameter of the saw blade is 600 mm or greater.

The crown guard for the exposed part of the saw blade should be rigid and easily adjustable, but not easily deflected. The crown guard should extend from the top of the riving knife to a point above, and as close as practicable to, the work piece. The crown guard should extend down each side of the saw blade, and the adjustment should ensure that the roots of the teeth are covered at all times.

The ripping fence, if used, should be accurately adjusted to not extend more than 50 mm beyond the tips of the saw teeth, in the direction of feed.

For machines with a single working spindle speed, saw blades with a diameter below 60% of the largest diameter the machine is designed to use should not be used. For machines with more than one working spindle speed, saw blades with a diameter below 60% of the largest diameter the machine is designed to use at the fastest working speed should not be used. A notice specifying the smallest diameter saw blade that can be used on the machine should be clearly displayed on the machine.

Only a competent trained employee should use circular sawing machines.

NOTE 1 The trained person should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D & T Association.*

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust and any action required to prevent or control the risks (see **10.1**).

Circular sawing machines can produce noise levels about 100 dB(A). A competent person should carry out an assessment of daily personal exposures.

*NOTE 2 Any person exposed to this level of noise for more than a few minutes each day has to be protected at the first or the second action level specified in the Control of Noise at Work Regulations 2005 (see **4.5**).*

Suitable eye protection should be used if deemed appropriate by the risk assessment. Long hair should be protected from entanglement.

Ear protection should be used if a noise risk assessment indicates that daily personal exposures exceed the action levels specified in the Control of Noise at Work Regulations 2005.

Circular sawing machines should not be used if the user could be distracted.

A push stick (or correctly designed push block, if required) should be used for making any cut of less than 300 mm and for feeding the last 300 mm of longer cuts. Long lengths of timber should be properly supported during cutting. If an assistant helps in drawing off, it is essential that a suitable extension table is provided, to a minimum distance of 1 200 mm between the up-running part of the saw blade and the further edge of the extension table.

Saw blades should be kept sharp, and should be of the correct profile and properly set. Saw blades should conform to BS EN 847-1. Saw blades that have been subjected to overheating should be discarded. It is essential that the saw blade has the correct number of teeth, as an insufficient number can cause timber to "kick back". Tungsten carbide tipped saw blades should be inspected regularly for chipped teeth and small cracks between the tips and the body of the blade, and discarded or repaired as appropriate.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.6.3 Powered fret sawing machines

10.6.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Hands or fingers can come into contact with the saw blade.

b) The powered fret sawing machine can become detached from the bench.

c) Wood dust can be inhaled.

d) Inadvertent starting of the machine can present a hazard.

10.6.3.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or suitable other control device that can quickly stop the machine in an emergency.

The saw should be securely fixed to the bench. Alternatively, if on a floor mounted stand, the stand should be securely fixed. The height of the machine should be set for comfortable working as appropriate.

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust, and any action required to prevent or control the risks (see **10.1**).

Suitable eye protection should be used if deemed appropriate by the risk assessment. Long hair should be protected from entanglement.

Blades should be sharp, and should be of the correct pattern and distortion-free. (Blunt or distorted blades can break in use.) Blades should be guarded at all times. The hold-down foot should be used where possible.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.6.4 Chop and radial arm sawing machines

WARNING. Students may only use chop and radial arm saws when they have been assessed and the assessment has shown that they are competent, and they are under the direct supervision of specifically trained staff.

10.6.4.1 Hazards

Employees should be aware of the following hazards.

a) Hands or fingers can come into contact with the saw blade.

b) The saw blade can become loose.

c) The blade can move forward inadvertently.

d) Wood dust can be inhaled.

e) Inadvertent starting of the machine can present a hazard.

f) Blunt or damaged saw blades can present a hazard.

10.6.4.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;

- fixed guards (removable only with the use of a tool) that enclose the drive mechanisms.

It should be possible to lock the machine to "off" when not in use, if a locking device is not incorporated in the machine.

It is essential that an appropriate means of stopping the machine in the event of an emergency is provided, in a position readily accessible to the operator during use.

The saw should be securely fixed to the bench or the floor, as appropriate. The height of the machine should be set for comfortable working, as appropriate.

The machine should be fitted with a fixed guard to enclose the non-cutting part of the saw blade. There should be no access to the saw blade when the machine is in the rest position. Self-closing guards that rise and open on contact with the work piece can achieve this. The machine should be equipped with an adjustable nose guard that should be adjustable within 12 mm of the table.

Machines should be fitted with a spring assisted return mechanism so that the saw unit returns to its safe rest position when it is released.

Ripping operation should not be carried out on a radial arm saw (a circular saw should be used for this).

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust, and any action required to prevent or control the risks (see **10.1**).

Suitable eye protection should be worn. Long hair should be protected from entanglement.

The machine should not be used if the user could be distracted.

Blades should be sharp, and should be of the correct pattern and distortion-free. (Blunt or distorted blades can break in use.)

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.6.5 Vertical panel circular sawing machines

*NOTE All circular sawing machines are "high-risk woodworking machinery" (see **10.1**).*

WARNING. Students in schools and sixth form colleges should not use vertical panel circular sawing machines.

10.6.5.1 Hazards

Operators should be aware of the following hazards.

a) Hands or fingers can come into contact with the blade.

b) The blade running on after the machine is switched off can present a hazard.

c) Wood dust can be inhaled.

d) Noise can cause permanent hearing damage.

e) Inadvertent starting of the machine can present a hazard.

f) Damaged power leads present the risk of electric shock.

10.6.5.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency. This may be the normal off button;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the motor/drive mechanisms.

It should be possible to lock the machine to "off" when not in use, if a locking device is not incorporated in the machine.

There should be sufficient space around the panel saw so that the boards can be handled safely. The floor of the work area should be level. The floor surface should be kept free from loose material and should be non-slippery.

Boards should be located in the correct mounts provided with the machine. Horizontal cuts should only be undertaken with the board located against an appropriate stop.

The part of the blade extending from the main guard of the machine should be protected by a spring loaded guard that retracts when the machine is brought into contact with the material.

For machines with a single working spindle speed, saw blades with a diameter below 60% of the largest diameter the machine is designed to use should not be used. For machines with more than one working spindle speed, saw blades with a diameter below 60% of the largest diameter the machine is designed to use at the fastest working speed should not be used. A notice specifying the smallest diameter saw blade that can be used on the machine should be clearly displayed on the machine.

Only a competent trained operator should use circular sawing machines.

NOTE 1 The trained person should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D&T Association.*

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust and any action required to prevent or control the risks (see **10.1**).

Vertical panel sawing machines can produce noise levels above 100 dB(A). A competent person should carry out an assessment of daily personal exposures.

*NOTE 2 Any person exposed to this level of noise for more than 30 min each day has to be protected at the first or the second action level specified in the Control of Noise at Work Regulations 2005 (see **4.5**).*

Suitable eye protection should be used. Long hair should be protected from entanglement.

Saw blades should be kept sharp, and should be of the correct profile and properly set. Saw blades should conform to BS EN 847-1. Saw blades that have been subjected to overheating should be discarded. It is essential that the saw blade has the correct number of teeth, as an insufficient number can cause the cutting head to "kick back". Tungsten carbide tipped saw blades should be inspected regularly for chipped teeth and small cracks between the tips and the body of the blade, and discarded or repaired as appropriate.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

10.7 Wood turning lathes

10.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled in moving parts of the lathe.

b) Hand held wood turning tools can become trapped between the rest and the work piece.

c) Work pieces can fly off if not correctly mounted to a face plate, chuck or between centres.

d) Timber particles can fly off poorly selected or prepared wood.

e) Inadvertent starting of the machine can present a hazard.

f) Lack of space around the machine can lead to the operator being pushed by passers-by.

g) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

h) Wood dust can be inhaled.

10.7.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items and wood shavings.

Only one person at a time should operate the machine.

It is essential that suitable eye protection is used while operating the machine. Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Timber should be inspected carefully to ensure it is free from any defect and it should be prepared in a roughly circular or octagonal shape before commencing machining operations. Segmented material should not be turned. If jointed material is used (e.g. in pattern making) it should be turned under close supervision.

Care should be taken to ensure that work mounted to a faceplate, a chuck or between centres is properly secured and balanced to prevent excessive vibration. The rotational clearance should be checked by hand before starting the machine.

Only one side of the headstock should be set up for work and the unused end of the headstock mandrel protected.

The machine should be electrically isolated before the speed is changed. A safe peripheral turning speed is important and this speed should be adjusted as appropriate for:

- the material;
- the diameter of the material;
- the condition of the turned surface.

The tool rest should be set at the correct height and fixed close to the work piece. Wood turning tools should be held securely and at the correct cutting angle. Tools should be kept sharp and should make a secure fit in their handles. Improvised tools, such as tools made from files, should not be used.

The machine should be stopped before measuring, gauging or adjusting the tool rest.

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust, and any action required to prevent or control the risks (see **10.1**).

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

10.8 Mitre trimmers

10.8.1 Hazards

Employees and students should be aware of the following hazards.

a) Contact with the blade can result in serious injury.

b) Inadvertent starting of the mitre trimmer can present a hazard.

c) Insufficient fixing to the bench can present a hazard.

10.8.2 Risk control measures

The mitre trimmer should be securely fixed and the blade immobilized when not in use. The mitre trimmer should not be left in an operational mode. If possible, the operating handle should be removed.

The mitre trimmer blade can cause serious injury and cannot be effectively guarded. Only competent persons should use mitre trimmers.

Blades should be kept sharp. Sliding mechanisms and guides should be kept clean.

11 Metalworking machinery

11.1 General

Metalworking machines are often used to machine materials other than metals in schools and similar establishments. It is essential that risk assessments are made if materials other than metals are used.

NOTE Metalworking machines are covered by the Supply of Machinery (Safety) Regulations 1992 (as amended), the Provision and Use of Work Equipment Regulations 1998 and BS EN 60204-1.

It is essential that persons who supervise, teach or work in machine areas have been adequately trained as required in the *Health and Safety Training Standards in Design and Technology* (published by the D & T Association), or hold other recognized qualifications to industry standards.

The school or similar establishment should decide which machinery is suitable for use by each group of students. The decision should be based on student maturity and competence, the level of supervision, and local authority/employer and national guidelines. In general the following recommendations apply.

a) Students should be trained and instructed in safe operating methods by a competent employee, who has attended a recognized training course. A record of their training should be kept.

b) Students should be assessed as mature and competent before operating the machinery, and should be continuously supervised.

For recommendations regarding CNC machining centres see **16.4**.

11.2 Centre lathes

11.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled in moving parts of the lathe.

b) Work pieces, chuck keys, broken cutting tools, swarf, etc., can be violently ejected from the lathe.

c) Centre lathes can present a hazard of electrical shock.

d) Closing movements between parts under power feed can be a trapping hazard.

e) Sharp edges on tools, work pieces and swarf can cause cuts.

f) Contact with cutting fluids, oil and grease can irritate the skin.

g) Swarf can jam or be ejected if allowed to build up.

h) Inadvertent starting of the machine can present a hazard.

i) Lack of space around the machine can lead to the operator being pushed by passers-by.

j) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

k) Manual handling (lifting) of heavy equipment (e.g. chucks, faceplates) can present a hazard.

11.2.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms including the headstock spindle end.

The machine should be fitted with a suitable chuck guard. The spindle mandrel should be guarded. If feed shafts and lead screws are not sufficiently protected by the overhang of the bedways and/or saddle and swarf trays, an appropriate guard should be provided.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items and swarf.

Only one person at a time should operate the machine.

It is essential that suitable eye protection is used while operating the machine. Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Heavy grade gloves should not be worn.

Manual handling tasks associated with changing heavy chucks and faceplates, etc., can be beyond the physical ability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated before any internal mechanisms are adjusted. The drive to feed shafts and lead screws should be disconnected until required. The chuck key, preferably spring-loaded, should be removed immediately after use and before starting the machine.

Care should be taken to ensure that work mounted to a faceplate, a chuck or between centres is properly secured and balanced to prevent excessive vibration. The rotational clearance should be checked by hand before starting the machine. The cutting tool should also be carefully checked for security before starting the machine.

Stock bar should not project beyond the headstock. If this is unavoidable, the portion of stock bar projecting beyond the headstock should be guarded to prevent entanglement.

Coolant nozzles should not be adjusted while the machine is in operation.

The machine should be stopped before measuring or gauging, and the cutting tool positioned to minimize possible contact.

Files and abrasive tape should not be used on centre lathes if possible. Tool-post grinders should only be used on lathes for which they have been specifically designed.

NOTE 1 For recommendations regarding the use of abrasive wheels see ***11.5****.*

Swarf should not be allowed to accumulate as it can become entangled or ejected by the chuck or work piece. Swarf should not be removed while the machine is operating. A suitable implement should be used to avoid hand contact with swarf.

Metalworking fluids, if used, should be mixed and changed in accordance with the supplier's instructions.

Contact with the skin should be kept to a minimum. Barrier creams or appropriate protective close fitting gloves may be used.

Hands should be washed thoroughly after using the machine.

Only a competent trained person should supervise the use of centre lathes.

NOTE 2 The trained person should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D & T Association.*

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.3 Milling machines (horizontal and vertical)

11.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Contact with revolving cutters can present a hazard.

b) Long hair, loose clothing, etc., can become entangled with rotating cutters or arbors.

c) Broken cutters, swarf, work pieces, etc., can be violently ejected.

d) Closing movement between parts, under power feed, can result in finger trapping.

e) Closing movement between the table and fixed structures can result in body crushing.

f) Heavy objects such as vices and index fixtures can fall from the table.

g) Milling machines can present a hazard of electric shock.

h) Sharp edges on cutters, work pieces and swarf can cause cuts.

i) Contact with cutting fluids, oils and greases can irritate the skin.

j) Inadvertent starting of the machine can present a hazard.

k) Lack of space around the machine can lead to the operator being pushed by passers-by.

l) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

m) Manual handling of heavy equipment such as vices and index fixtures can present a hazard.

11.3.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards, that enclose the drive pulleys, belts and gears.

Guards should prevent access to dangerous in-running nips on the pulleys or gearwheels. Cutters should be guarded while in motion to prevent access. Ends of rotating arbors should be fitted with guards to prevent entanglement.

Milling machines should be fitted with a space of at least 500 mm between the machine table at the extreme ends of its travel and any fixed object.

Handles or hand wheels to operate the table mechanism should be set up so that they do not rotate when the power drive is engaged.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

It is essential that suitable eye protection is used while operating the machine. Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Heavy grade gloves should not be worn.

Manual handling tasks associated with moving heavy work, vices and indexing heads can be beyond the physical capability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated before any internal mechanisms are adjusted. It is essential that the cutters are stopped when positioning the work piece, clearing swarf, adjusting coolant hoses, measuring or gauging.

Hands should be kept away from the table while it is traversing under power to minimize the risk of trapping fingers.

Suitable implements should be used to remove swarf to avoid hand contact.

If metalworking fluids are used, they should be mixed and changed in accordance with the supplier's instructions. Contact with the skin should be kept to a minimum. Hands should be washed thoroughly after use. Barrier creams or appropriate protective close fitting gloves may be used.

Only a competent trained person should supervise the use of milling machines.

NOTE The trained person should be trained in accordance with the Health and Safety Training Standards in Design and Technology, *published by the D & T Association.*

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.4 Drilling machines

11.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled in moving parts of the drilling machine.

b) Chuck keys, broken drills, swarf, work pieces, etc., can be violently ejected.

c) Unexpected spinning of hand held work pieces could cause injuries to hands.

d) The drill table can slip down or heavy objects fall from the table.

e) Drilling machines present an electric shock hazard.

f) Closing movements between parts can lead to trapping.

g) Sharp edges on drills, work pieces and swarf can cause cuts.

h) Contact with metalworking fluids, oil and grease can irritate the skin.

i) Inadvertent starting of the machine can present a hazard.

j) Lack of space around the machine can lead to the operator being pushed by passers-by.

k) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

11.4.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a foot operated emergency stop device so that the machine can be quickly stopped in an emergency, without requiring the operator to let go of the spindle feed or work piece;

- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive pulleys and belts (guards should prevent access to dangerous in-running nips on the pulleys).

There should be sufficient clear space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

It is essential that suitable eye protection is used while operating the machine. Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves or bandages should not be worn while operating the machine.

Manual handling tasks associated with changing/moving heavy drill tables and vices, etc., can be beyond the physical capability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated before the position of the drive belt is changed. The chuck key, preferably spring-loaded, should be removed immediately after use and before starting the machine.

NOTE 1 A high proportion of accidents at drilling machines occur when the work piece is being put into position, with the drill bit at its uppermost point. It is essential that the drilling machine is fitted with a suitable guard that extends to the bottom of the drill bit when it is in the uppermost position. The table should then be adjusted so that, as the drill bit leaves the guard, it enters the work piece.

NOTE 2 When using a specialist printed circuit board drilling machine, the need for a guard should be ascertained by a specific risk assessment.

Where appropriate, the work piece should be prevented from spinning around by use of a vice or hand grips, or by clamping it to the table.

NOTE 3 A vice or clamping might not be required if a small diameter drill is used. In this case it might be sufficient to hold the work piece by hand; but a risk assessment should be carried out first.

If no rack and pinion rise and fall mechanism is provided for table adjustment, the safety collar stop under the table should be used. If the head is adjustable, care should be taken to ensure that the safety collar stop underneath it is secure.

Suitable implements should be used to remove swarf, so that hand contact is avoided.

If metalworking fluids are used, they should be mixed and changed in accordance with the supplier's instructions. Contact with the skin should be kept to a minimum and hands should be washed thoroughly after use.

Coolant nozzles should not be adjusted while the machine is in operation.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.5 Grinding machines

NOTE Although the Abrasive Wheels Regulations 1970 have been superseded by the Provision and Use of Work Equipment Regulations 1998, the sections covering training of persons to mount abrasive wheels, on guarding of wheels, and on measures to prevent wheels overspeeding, are still recognized as good practice guidelines. These are also detailed in the Health and Safety Executive publication HSG 17, Safety in the Use of Abrasive Wheels.

11.5.1 Bench and pedestal grinding machines

11.5.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Overspeeding, damaged or incorrectly mounted abrasive wheels can break while rotating and be violently ejected from the grinding machine.

b) Contact with the wheel can cause cuts.

c) Long hair, loose clothing, etc., can become entangled with the spindle or wheel.

d) Work pieces can be ejected from the machine.

e) Fingers or work pieces can become jammed between the wheel and rest.

f) Hot work pieces can cause burns.

g) Grinding machines can present a hazard of electric shock.

h) Sharp edges can cause cuts.

i) Inadvertent starting of the machine can present a hazard.

j) Dust can be inhaled.

k) Lack of space around the machine can lead to the operator being pushed by passers-by.

l) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

11.5.1.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- a suitable guard to enclose the wheels and spindles. The guard should be able to contain debris from a wheel breaking in motion and should prevent entanglement with the threaded spindle ends (the only gap in the guard should be at the front to allow access for the work piece).

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

A risk assessment should be carried out on dust inhalation at the machine.

NOTE Normal room ventilation is likely to be sufficient for dust from grinding machines, but, depending on the materials and scale of use, additional measures might be required (e.g. local exhaust ventilation or respiratory protective equipment).

It is essential that suitable eye protection is used while operating the machine. Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Wheels should be suitable for the material of the work piece and should be mounted correctly by a competent person in accordance with the manufacturer's instructions. The maximum operating speed marked on the wheel should not be exceeded. Care should be taken to ensure that the spindle speed is marked on the machine.

The work rest should be adjusted as close as possible to the wheel to prevent fingers and work pieces from becoming jammed. The gap between the work rest and wheel should not exceed 3 mm. Spark arrester(s), where fitted, should be adjusted correctly.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.5.2 Surface grinding machines

11.5.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Overspeeding, damaged or incorrectly mounted abrasive wheels can break while rotating and be violently ejected from the grinding machine.

b) Contact with the wheel can cause cuts.

c) Long hair, loose clothing, etc., can become entangled with the spindle or wheel.

d) Work pieces can be ejected from the machine.

e) Fingers or work pieces can become jammed between the wheel and rest.

f) Hot work pieces can cause burns.

g) Grinding machines can present a hazard of electric shock.

h) Sharp edges can cause cuts.

i) Inadvertent starting of the machine can present a hazard.

j) Dust can be inhaled.

k) Lack of space around the machine can lead to the operator being pushed by passers-by.

l) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

m) Closing movement between parts under power feed can result in finger trapping.

n) Closing movement between the table and fixed structures can result in body crushing.

o) Unsecured work pieces can be violently projected off the end of the table.

p) Contact with metalworking fluids can irritate the skin.

11.5.2.2 Risk control measures

The recommendations given in **11.5.1.2** apply to surface grinding machines, together with the following recommendations.

Surface grinding machines require a space of at least 500 mm between the machine table at the extreme ends of its travel and any fixed object.

The end of the table from which an unsecured work piece could be projected from the wheel should be fitted with a substantial guard, or should face towards a wall.

Drive mechanisms should be provided with fixed guards that require use of a tool for removal, or alternatively should be interlocked to prevent access while in motion.

It is essential that suitable eye protection is used while operating the machine. Substantial protective footwear should be worn.

The machine should be electrically isolated before any internal mechanisms are adjusted.

The wheel should be balanced to minimize vibration if required. Coolant nozzles should not be adjusted while the machine is in operation.

Care should be taken to check that the work piece is properly secured before starting the machine (special care should be taken if magnetic tables are used). It is essential that the wheel is stopped prior to positioning the work piece, measuring or gauging. Hands should be kept away from the table while it is traversing under power, to minimize risk of trapping of fingers.

If metalworking fluids are used, they should be mixed and changed in accordance with the supplier's instructions. Contact with the skin should be kept to a minimum. Hands should be washed thoroughly after use.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.5.3 Polishing (buffing) machines

11.5.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled with the spindle, mop or brush.

b) Work pieces, wires from brushes and particles from the polishing process can be ejected from the machine.

c) Hot work pieces can cause burns.

d) Polishing machines can present a hazard of electric shock.

e) Sharp edges can cause cuts.

f) Inadvertent starting of the machine can present a hazard.

g) Dust can accumulate and can be inhaled.

h) Lack of space around the machine can lead to the operator being pushed by passers-by.

i) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

11.5.3.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms;
- a suitable guard to protect the brush or mops. (The only gap in the guarding should be at the front to allow access for the work piece. The guard should be able to prevent entanglement with the spindle ends and threaded mandrel.)

There should be sufficient clear space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

A risk assessment should be carried out on dust inhalation at the machine.

NOTE Normal room ventilation might be sufficient for dust from grinding machines but, depending on the materials and scale of use, additional measures might be required (e.g. local exhaust ventilation or respiratory protective equipment).

It is essential that suitable eye protection is used while operating the machine. Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Wire brushes and mops should be suitable for the work and should be mounted so as not to come loose while in motion.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.5.4 Abrasive belt machines (linishing machines)

11.5.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled with the belt or drive pulleys.

b) Fingers or the work piece can become trapped in pulley/belt in-running nips.

c) Contact with the edge of the belt can cause cuts.

d) Hot work pieces can cause burns.

e) Abrasive belt machines can present a hazard of electric shock.

f) Sharp edges can cause cuts.

g) Inadvertent starting of the machine can present a hazard.

h) Dust can be inhaled.

i) Lack of space around the machine can lead to the operator being pushed by passers-by.

j) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

11.5.4.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms;
- a guard over the in-running nips created by the belt and pulleys to prevent traps. (The in-running fence should be kept as close as possible to the belt surface to prevent traps.)

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

A risk assessment should be carried out on dust inhalation at the machine.

NOTE Normal room ventilation might be sufficient for dust from grinding machines, but depending on the materials and scale of use, additional measures might be required (e.g. local exhaust ventilation or respiratory protective equipment).

It is essential that suitable eye protection is used while operating the machine. Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

The machine should be electrically isolated before any internal mechanisms are adjusted. Abrasive belts should be examined before use. Torn or badly worn belts should not be used.

Abrasive belts should be narrower than the belt support plate and pulleys (to protect the belt edges and eliminate the risk of cuts). Abrasive belts should be suitable for the material of the work piece. They should be fitted to run in the correct direction and adjusted so as not to break or come loose while in motion.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.6 Sawing machines, power hacksaws and metal cutting bandsaws

WARNING. Students may only use sawing machines when they have been assessed and the assessment has shown that they are competent, and they are under the direct supervision of specifically trained staff.

11.6.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled in moving parts.

b) Closing movements between parts can result in trapping.

c) Forward motion of the saw (power hacksaw) arm can result in trapping or cuts.

d) The bar stock projecting from the vice can present a tripping hazard.

e) Sawing machines can present a hazard of electric shock.

f) Sharp edges on tools and work pieces can cause cuts.

g) Blunt or damaged blades can present a hazard.

h) Contact with cutting fluids, oil and grease can irritate the skin.

i) Inadvertent starting of the machine can present a hazard.

j) Lack of space around the machine can lead to the operator being pushed by passers-by.

k) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

l) Manual handling of bar stock can present a hazard.

11.6.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently and safely positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool) or alternatively interlocked guards, that enclose the drive pulleys, belts and gears. (Guards should prevent access to dangerous in-running nips on the pulleys or gearwheels.)

Blade guides on bandsaws should be correctly adjusted for the size of the material being cut and for the size of the blade itself.

Badly worn or damaged blades should not be used.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

Reciprocating power hacksaw machines require a space of at least 500 mm between the saw arm at the extreme ends of its travel and any fixed object.

It is essential that suitable eye protection is used while operating the machine. Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed.

Measures should be taken to prevent persons tripping over long bars being sawn. Manual handling tasks associated with moving bar stock should be assessed and measures implemented, as appropriate, to minimize risks (e.g. team lifts, correct lifting techniques, care of passers-by).

Work pieces should be securely held in the vice and properly supported (on both sides of the cut if required). Long, heavy bars should be properly supported to prevent sawn parts from falling or tipping when the vice is unclamped. On reciprocating power hacksaws, hands should be kept away from the saw arm and drive crank while these are in motion. The saw should not be manually assisted to increase the rate of cutting.

The machine should be electrically isolated before any internal mechanisms are adjusted. Coolant nozzles should remain in position during machining. Care should be taken not to spill coolant.

If metalworking fluids are used, they should be mixed and changed in accordance with the supplier's instructions. Contact with skin should be kept to a minimum. Hands should be washed thoroughly after use.

The machine should be fitted with an auto finished cut knock-off switch. The switch should be utilized at all times and regularly checked to ensure that it is in good order.

The hydraulic dashpot or damping device should be maintained in good working order.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.7 Guillotines, shears (hand or treadle operated), folding and rolling machines

11.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Closing movement between surfaces and other parts can result in trapping and serious injury.

b) Sharp edges on cut materials can cause cuts.

c) Lack of space around the machine can lead to the operator being pushed by passers-by.

d) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

e) Manual handling of sheet materials and operating levers or treadles can present a hazard.

f) Entanglement of long hair, loose clothing, etc., in moving parts can present a hazard.

11.7.2 Risk control measures

Sheet cutters should preferably be of the "nibbler" or "notching" type. Where bench shears and guillotines are used, a specific risk assessment should be undertaken.

These machines should be secured to a bench or stand specifically designed for the purpose.

It is essential that a guard is provided on machines with a worktable, that prevents access to shearing points from all positions. (See also HSE publication HSG 42, *Safety in the Use of Metal Cutting Guillotines and Shears*.)

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed.

When the machine is not in use, it should be made safe by locking the action and, if possible, removing the operating handle. Only one person should operate the machine at any time and industrial type gloves should be worn to handle materials. Only material within the capacity of the machine should be cut, to minimize physical effort and to prevent damage to the machine. Sheet material should be properly supported during cutting.

Manual handling tasks associated with moving sheet materials should be assessed and measures implemented as appropriate to minimize risks (e.g. team lifts, correct lifting techniques, care of passers-by).

Shearing edges should be maintained in good condition, and should be distortion-free and correctly adjusted.

These machines should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.8 Lapidary equipment

11.8.1 Hazards

Employees and students should be aware of the following hazards.

a) Grinding and polishing stones produces a very fine dust that can cause serious respiratory irritation.

b) Pieces of stone can be ejected from the machine.

c) The work area can become wet and slippery.

11.8.2 Risk control measures

11.8.2.1 Grinding units

Abrasive wheels on the grinding unit should be run in water at all times to ensure that dust particles are carried away safely. Care should be taken when disposing of slurry from grinding as slurry can block drainage systems. Waste should be allowed to settle, the water drained off, and solids removed.

Water should be drained from the trough when the unit is not in use.

A risk assessment should be carried out and suitable personal protective clothing provided. Suitable eye protection should be worn.

Stone should be mounted on a dop stick for grinding. Stone should not be held by hand.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

11.8.2.2 Cutting units

Care should be taken to ensure that the diamond saw blade on the cutting unit is true.

A risk assessment should be carried out and suitable personal protective clothing provided. It is essential that suitable eye protection is worn.

Cutting oil or water should be used to cool the saw blade. Care should be taken to ensure that stone dust is carried away safely. Cutting oil spilt on the bench top or floor should be cleaned away immediately.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

12 Motor vehicle work, machinery and equipment

12.1 Hazards

Employees and students should be aware of the following hazards.

a) Moving vehicles can crush or run over persons.

b) Vehicles or components falling from supports, lifting equipment or vehicle hoists can trap or crush.

c) Moving parts can trap or entangle.

d) Inadvertent moving of vehicles and starting of engines/display machinery can present a hazard.

e) Petrol vapours can cause fires or explode.

f) Exhaust fumes can be inhaled.

g) Inspection pits can accumulate flammable vapours/exhaust fumes.

h) Inspection pits can present a falling hazard.

i) High-tension ignition equipment can present an electric shock hazard.

j) Batteries give off an explosive hydrogen and oxygen mixture during and after charging.

k) Arcing caused by making and breaking a circuit at battery terminals can cause batteries to explode.

l) Short circuiting battery terminals or other connections can cause burns or ignition of flammable gases and vapours.

m) Spilt oils/fluids and untidy work areas can cause slips and falls.

n) Dust from brake and clutch linings (which can contain asbestos) can be inhaled.

o) Hot exhaust system surfaces and brake discs/drums can cause burns.

p) Hot cooling systems, engine oil and automatic transmission and power steering fluids can cause scalding and burns.

q) Used engine/transmission oils and hydraulic fluids can irritate the skin.

r) Hydrofluoric acid from burnt or overheated synthetic rubber oil seals, O-rings and fuel pipes can cause burns.

s) Unintentional operation of air bags can present a hazard.

t) Fuel from high-pressure diesel/petrol injection systems can spray into eyes and onto the skin and can penetrate the skin.

u) Manual handling (lifting) of heavy components, materials and tools can present a hazard.

12.2 Risk control measures

12.2.1 General

Vehicle ignition keys should be kept by a competent person. Persons should be assessed as being competent and properly qualified before moving or road testing vehicles. Care should be taken when reversing vehicles in restricted areas.

Work areas should be kept tidy to minimize risks of falls. Equipment should be stored away after use. Trailing cables should not be used if possible. Work systems should be organized to minimize the likelihood of oils and fluids spilling onto floors. Spills should be cleaned up using absorbent granules or sawdust.

Engines should not be run indoors unless the vehicle exhaust is clear of the building or is vented via an extraction pipe to the outside.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Suitable close fitting overalls should be worn. Protective headgear should be worn when working under vehicles on hoists.

Contact with used engine/transmission oils and hydraulic fluids should be minimized by the work systems used and by the use of suitable protective gloves (e.g. disposable vinyl/latex gloves). Hands should washed thoroughly after work with suitable hand cleansers. Nail brushes and barrier cream should be provided.

Care should be taken while engines are running for setting/fault diagnosis, etc., to ensure that hands/fingers/clothing/hair/rags are kept away from trapping and entanglement points on pulleys and belts.

Manual handling tasks associated with moving heavy equipment and components can be beyond the capability of some persons. An assessment should be carried out and measures implemented to minimize risks (e.g. lifting aids, team lifts, correct lifting techniques).

High-tension ignition voltages present a significant risk, especially to persons with heart problems or a pacemaker. Work should not be carried out on or near to ignition systems while the engine is running.

Care should be taken when working on fuel injectors and pipes to ensure that persons are not exposed to fuel sprays.

Care should be taken with burnt or overheated synthetic rubber components (seals, O-rings, fuel pipes). (These appear as charred and sticky and contain hydrofluoric acid which is highly corrosive and difficult to remove from the skin.) If there is any doubt, any charred rubber component should be assumed to be synthetic. Protective gloves should be worn. If contact is made with the skin, the area should be washed immediately and medical attention obtained.

Radiator or expansion tank caps should not be removed while the engine is hot. Care should be taken to prevent contact with hot engine oil, exhausts or brake discs or drums.

The manufacturer's instructions should be complied with when working near to, or removing, the steering wheel and/or facia.

12.2.2 Batteries and chargers

Areas used for battery charging should be properly ventilated to prevent accumulation of a hydrogen and oxygen gas mixture.

Arcing near to battery terminals should be avoided as follows.

- Jump leads should be connected in the sequence recommended by the vehicle manufacturer. The last connection (where the circuit is made and where arcing might occur) should be made on the earthed bodywork at least 500 mm from the battery.
- Battery chargers should be switched off before connecting to terminals.
- Metal objects should be prevented from falling across battery terminals.
- The battery earth terminal should be disconnected in accordance with the vehicle manufacturer's instructions to prevent tools arcing on live connections.
- Rings and metal wrist jewellery should be removed before carrying out work.

12.2.3 Demonstration engines and ancillary equipment

Static displays should be securely supported to prevent falling and any moving parts that could trap hands/fingers should be guarded or locked to prevent unauthorized movement.

Keys to locking devices and engine ignition keys should be kept by a competent person.

12.2.4 Fuel tanks

Repairs to fuel tanks should only be carried out by specialists. Hot work should not be attempted on or near to a petrol tank.

All work on fuel systems should be carried out in a properly ventilated area (preferably outdoors).

Fuel siphoning should be carried out using a siphon pump (not by mouth suction on a tube). Fuel should be drained into suitable containers. Care should be taken to ensure that tanks are completely drained before components, such as fuel gauge sender units, are removed.

Sources of ignition should be excluded from areas in which fuel vapours can be present.

Handlamps can ignite fuel vapours if the lamp breaks. Only handlamps that are suitable for use in explosive atmospheres should be used. Guidance is given in HSE Guidance Note PM 38 *Selection and Use of Electric Handlamps*.

NOTE For general advice on electrical equipment for work with motor vehicles, etc., see HSE booklet HSG 67 Health and Safety in Motor Vehicle Repair.

Fuel should be stored in a locked, external, fireproof store that is well ventilated. The store should be labelled to show that it contains fuel and also should have affixed to it a hazard sign indicating "Beware flammable material" conforming to BS 5499-5. The amount of fuel stored should not exceed 20 litres. If stored in quantities of 10 litres, storage should be in metal containers. If plastics containers are used only 10 litres may be stored. Fuel should be stored in containers that are marked as being suitable for the storage of fuel.

12.2.5 Brake and clutch linings

Old vehicles might have brake and clutch linings fitted with asbestos materials. It is essential that if old vehicles are used for demonstration or exercises, linings are removed prior to students starting work on the vehicle. The following precautions should be taken when removing brake and clutch linings and disc pads that might contain asbestos.

- Care should be taken to avoid inhaling dust from brake assemblies and clutch housings.
- Compressed air should not be used to remove dust from brakes or clutch housings.
- Proprietary brake cleaners should be used that prevent dust from becoming airborne.

Advice on disposal of asbestos containing materials should be obtained from the local waste regulation authority.

12.2.6 Vehicle hoists

NOTE The Lifting Operations and Lifting Equipment Regulations 1998 cover vehicle hoists.

The hoist manufacturer's instructions and recommendations should be complied with. The weight distribution of the vehicle and the effects on the weight distribution of removal of components should be continuously assessed.

Hoists should be marked with the safe working load.

The safe working load should not be exceeded.

Only competent employees should operate hoists. To prevent falls, persons should not ride on hoist platforms, and raised platforms should not be used as working areas.

The operating switch for raising and lowering should be sprung so that movement stops when the switch is released. The switch should be positioned to allow the operator a clear view all around the hoist. On four post hoists, automatic chocking should be provided to prevent vehicles rolling off.

Hoists should be included in a planned inspection and maintenance programme carried out by a competent person.

12.2.7 Jacks and axle stands

NOTE The Lifting Operations and Lifting Equipment Regulations 1998 cover trolley, bottle and screw jacks.

Axle stands should be inspected by a competent person at regular intervals. All jacks and axle stands should be marked with the safe working load and this should not be exceeded.

Before any person carries out work on a raised vehicle, axle stands or other suitable supports should be positioned correctly to support and steady the vehicle. Suitable jacks should only be used to raise and lower the vehicle. Jacks and axle stands should be used only on suitable level, undamaged surfaces. Where necessary, vehicle movement should be prevented during jacking by using chocks. Care should be taken to avoid jacks and axle stands slipping.

Jacks and axle stands should be maintained in good condition and checked before use.

12.2.8 Inspection pits

As they are not appropriate in schools and similar establishments, inspection pits should not be used.

13 Moulding processes and equipment for plastics

13.1 Injection and extrusion moulding machines

13.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Hot or molten plastics discharges from injection moulding machines can cause burns.

b) Fumes can be inhaled.

c) The machine can become unstable and cause injuries.

d) Absorption of moisture by hygroscopic material (e.g. nylon) can present a risk of explosive discharges.

13.1.2 Risk control measures

It is essential that the machine is provided with a means of electrical isolation using a fused switch-disconnector on, or adjacent to, the machine.

The machine should be fitted with safety guards around the nozzle area to provide protection in all directions from possible ejection of hot material. Split moulds should be clamped prior to injection of plastics. Interlocking guards should be provided if the moulds are closed by any power driven system.

Certain plastics materials (especially nylon) absorb moisture. These materials should be stored in airtight drums, and dried in accordance with the manufacturer's instructions immediately before use.

WARNING. Absorbed moisture in plastics materials can form steam that can cause hot material to eject from the injection moulding machine.

Appropriate personal protective equipment (e.g. heat-resistant gloves or gauntlets) should be worn, based on a risk assessment. It is essential that suitable eye protection is worn.

The machine should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.2 Moulding trimming machines

13.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Cutting blades or discs and the drive mechanism can cause injuries.

b) Unstable equipment or work pieces can cause injuries.

c) Trimmed material can cause injuries.

13.2.2 Risk control measures

It is essential that the machine is provided with:

- a means of electrical isolation using a fused switch-disconnector on or adjacent to the machine, and that it is controlled by a starter incorporating overload protection and no-volt release;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency.

Drive mechanisms should be provided with fixed guarding that requires a tool for removal. Interlocked guards and cutter guards should be provided where practicable. Adjustable fences or guides should be provided if there is a risk of "snatching".

Care should be taken that hands are kept well away from the blade when holding and moving the material.

It is essential that suitable eye protection is worn.

Moulding trimming machines should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.3 Vacuum forming machines

13.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes can be inhaled.

b) Overheated plastics can cause burns or a fire.

c) The pressure tank can fail and cause injury.

13.3.2 Risk control measures

Appropriate materials should be chosen (see **17.4**).

Fixed vacuum forming machines should be provided with a means of isolation (preferably a fused switch-disconnector on or adjacent to the equipment).

Portable vacuum forming machines should be powered by a mains socket outlet protected by a residual current device (RCD) (see **5.2.1**). The operational effectiveness of the unit should be verified and recorded on a frequent basis, by pressing the test button in accordance with the manufacturer's instructions. Plugs should conform to BS 1363-1 and should be fused in accordance with the equipment manufacturer's instructions. Plugs should be removed from the mains socket when the equipment is not in use.

The heater system should be shielded or guarded against accidental contact. The moving heater system should be mechanically attached to the machine.

It should be possible to regulate the output from the heater system. (On larger vacuum forming machines the heating element might be zoned.) If ceramic heaters are used, a mechanical interlock with the platen mechanism should be provided to prevent accidental elevation of a mould into the heaters.

Where harmful fumes are released, a risk assessment should be carried out to determine if local exhaust ventilation should be provided.

NOTE Most common materials are unlikely to produce significant fumes during vacuum forming and normal room ventilation is usually sufficient.

Vacuum forming machines should not be left unattended when plastics are being heated.

If fumes are produced by heated material, the machine should be switched off, and the room evacuated if required, and ventilated. A timer with an audible warning device should be provided to prevent overheating.

The machine should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.4 Hot wire cutters

13.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes and smoke can be inhaled.

b) Contact of the hot wire cutter with the skin can cause burns.

13.4.2 Risk control measures

Hot wire cutters should only be used to cut expanded polystyrene material.

Portable hot wire cutters should be powered via a socket outlet protected by a residual current device (RCD) (see **5.2.1**). The operational effectiveness of the RCD should be verified and recorded on a frequent basis, by pressing the test button in accordance with the manufacturer's instructions. Mains plugs should conform to BS 1363-1 and should be fused in accordance with the equipment manufacturer's instructions. Mains plugs should be removed from the socket when the cutters are not in use.

The electrical supply to the cutting wire or wires should not exceed 25 V and should be supplied from a separated extra-low voltage (SELV) source. The voltage should be adjustable to a level that does not produce fumes at typical cutting speeds.

If possible, a "push-to-make" foot or pressure operated switch should be provided to control the power supply to the cutting wire.

Where harmful fumes are released, a risk assessment should be carried out to determine if local ventilation should be provided.

The machine should be included in a planned maintenance programme that should include electrical safety tests.

13.5 Strip heaters and line bending heaters

13.5.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes can be inhaled.

b) Hot plastics and hot surfaces can cause burns.

c) Unstable equipment or work pieces can cause injury.

d) Strip heaters present an electric shock hazard.

13.5.2 Risk control measures

Appropriate materials should be chosen (see **17.4**).

Fixed strip heaters should be provided with a means of isolation (preferably a fused switch-disconnector on or adjacent to the equipment).

Portable strip heaters should be powered via a socket outlet protected by a residual current device (RCD) (see **5.2.1**). The operational effectiveness of the unit should be verified and recorded on a frequent basis, by pressing the test button in accordance with the manufacturer's instructions. Mains plugs should conform to BS 1363-1 and should be fused in accordance with the equipment manufacturer's instructions. Mains plugs should be removed from the socket when the equipment is not in use.

Line bending heaters with heated tensioned resistance wire should be of separated extra-low voltage (SELV) type and should have a transformer designed to protect against mains voltage breakdown to the secondary windings.

Simple heat output controls should be provided as well as an adjustable work support to control the distance between the heat source and the material.

Guarding should be provided if practicable or if the risk of causing burns is high.

Where harmful fumes are released, a risk assessment should be carried out to determine if local ventilation should be provided.

The equipment should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.6 Ovens

13.6.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes can be inhaled.

b) Hot surfaces can cause burns.

13.6.2 Risk control measures

The equipment should be provided with a means of isolation (preferably a fused switch-disconnector on or adjacent to the equipment).

Only thermostatically controlled electric ovens should be used to heat plastics materials (see **17.4**). The temperature controller should include a maximum heat limit facility set to 250 °C to 300 °C. The temperature controller should prevent excessive overheating when starting from cold.

Fan circulated ovens should be used if practicable.

External casing temperatures should not be excessive.

The oven chamber should be kept clean at all times.

A risk assessment should be carried out, and suitable personal protective equipment provided. Heat-resistant gauntlets should be used.

The equipment should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.7 Blow moulders

*NOTE As this piece of equipment is used in conjunction with a plastics oven these hazards and risk control measures should be read in conjunction with **13.6**.*

13.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes can be inhaled.

b) Hot plastics and hot surfaces can cause burns.

c) Unstable equipment or work pieces can cause injury.

d) Dome blowers present an electric shock hazard.

e) Compressed air presents a hazard (see **9.1.3**).

13.7.2 Risk control measures

It is essential that suitable eye protection is worn. Other appropriate personal protective equipment (e.g. heat-resistant gloves or gauntlets) should be worn, based on a risk assessment.

A risk assessment should be completed to cover the use of compressed air.

The appropriate material should be used at all times in accordance with the manufacturer's instructions and material data sheets (see **17.4**).

Suitable and sufficient training should be carried out before using the equipment. The equipment should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

13.8 Hot air plastics welding

13.8.1 Hazards

Employees and students should be aware of the following hazards.

a) Fumes can be inhaled.

b) Hot plastics, air and surfaces can cause burns or overheating.

c) Unstable equipment or work pieces can cause injury.

d) Hot air guns can cause burns either through contact with the air or the gun.

e) The equipment presents an electric shock hazard.

f) Leads and hoses could be tripped over.

13.8.2 Risk control measures

It is essential that suitable eye protection is worn. Other appropriate personal protective equipment (e.g. heat-resistant gloves or gauntlets) should be worn, based on a risk assessment.

The appropriate material should be used at all times in accordance with the manufacturer's instructions and material data sheets (see **17.4**).

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, others in the vicinity or the machine.

Suitable and sufficient training should be carried out before using the equipment. The equipment should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

14 Heat processes, plant and equipment for metals

14.1 Forging and brazing

14.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Care should be taken when carrying hot metals (particularly metals at black heat that might not appear hot).

b) Clay bricks should not be heated as they can disintegrate violently.

c) Ceramic chips remain hot for a considerable time after the heat source has been removed.

d) Foreign materials present in a forge can cause fumes. Stones can explode.

e) Quenching of hot metals, particularly tubular components, can present a risk of scalding.

f) Fuel combustion can produce dangerous gases.

14.1.2 Risk control measures

Firebrick or other refractory materials should be used for the brazing base. Anvils should be mounted on a stable base at an appropriate height for the user. Anvils and quenching tanks should be sited as close as possible to the hearth or forge.

LEV should be provided to remove fumes.

Appropriate personal protective equipment should be used. Strong, fire resistant aprons, gloves, face protection and sturdy protective footwear should be used.

A warning notice should be displayed where hot metal is left to cool.

Hot metal should be held using appropriately shaped tongs.

Tools should be appropriate and of the correct size for the work. They should be quenched and stored safely after use.

Floors should be kept clear of any loose materials and tools.

14.2 Welding and welding installations

14.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Compressed oxygen cylinders if damaged or involved in a fire can explode violently.

b) Oxygen leaks make fires burn quicker and more violently.

c) Cylinders of acetylene gas can explode violently if involved in a fire.

d) Acetylene gas leaks can form an explosive mixture inside buildings.

e) Welding equipment can present an electric shock hazard.

f) Sparks can cause burns to skin, eyes and clothes.

g) Hot metal components can cause burns.

h) Chipping or cleaning welds can lead to eye injuries.

i) Ultraviolet and infra-red radiation can cause “arc eye”, a painful (but usually temporary) eye condition.

j) Welding can present a fire hazard.

k) Explosive vapours can form inside containers that have contained flammable liquids.

l) Hazardous fumes can be produced.

m) Electromagnetic fields can affect the operation of pacemakers and other electronic medical devices.

14.2.2 General risk control measures

Persons supervising work in welding areas should be trained to a standard as specified in the *Health and Safety Training Standards in Design and Technology* (published by the D & T Association) or should have equivalent recognized qualifications to industry standards.

It is essential that welding areas are separated from other work areas by fixed or portable screens that protect persons not wearing suitable eye protection goggles.

Welding areas should be kept free of combustible materials and flammable liquids. A fire extinguisher and fire blanket should be readily available. Welding should not take place directly onto a dense concrete or non-refractory cement base, as these materials can disintegrate explosively when heated.

A good level of general ventilation should be provided. Concentrations of welding fumes should be avoided. It is essential that a risk assessment is carried out, and suitable control measures and local exhaust ventilation provided if required.

Users of welding equipment, and observers, should be protected against glare and sparks by appropriate goggles or shields. Goggles or shields should also be utilized when chipping or cleaning welds. Suitable protective clothing (gloves, aprons and substantial footwear) should be worn to minimize risks of spark burns and clothing damage. Protective clothing should be kept free of oil and grease.

In the educational environment, the welding, cutting or any other heat processes on tanks should not be undertaken.

Welded materials should be put in a safe place to cool, in order to minimize the risk of burns.

Welding equipment should be included in a planned annual maintenance programme that should include any appropriate electrical safety tests. Reference should be made to the HSE publication HSG 118, *Electrical Safety in Arc Welding*.

Wearers of vital electronic medical equipment (e.g. pacemakers) should consult their physician before beginning any arc welding, cutting, gouging or spot welding operations.

14.2.3 Metal-arc welding (including spot welding)

The mains supply circuit and connections to metal-arc welding equipment [manual metal arc (MMA), metal active gas (MAG), metal inert gas (MIG), tungsten inert gas (TIG)] should be able to supply the required input current. A competent electrician should be consulted if necessary.

Only equipment with open circuit output voltages of less than 50 V a.c. or 120 V d.c. should be used. Welding should be carried out in dry surroundings with dry equipment.

NOTE Older types of welding equipment require the work piece to be earthed as well as the welding return lead. This is to provide protection against internal insulation failure of the welding transformer, by keeping the work piece at or near to earth potential until the protective device (e.g. a fuse) operates to cut off the mains supply. The work piece earthing conductor should be robust enough to withstand possible mechanical damage, and should be connected to the work piece and a suitable earth terminal by bolted lugs or secure screw clamps. Newer equipment does not require the work piece to be earthed because the internal insulation is reinforced. Newer equipment should have an identification symbol (two circles within a shield) or should be marked with the appropriate standard number.

Users should remove all personal jewellery (especially rings, bracelets and metallic watchstraps) before carrying out any welding. (Welding currents can induce currents in these objects high enough to cause partial melting.)

Metal-arc welding should be carried out in areas that are painted black and are curtained or screened-off.

Care should be taken when putting down the electrode holder, which might be live, to prevent contact with other earthed objects (especially earthed electrical equipment). An insulated container or an insulated hook should be provided for this purpose. When welding is finished, the power supply should be switched off and the electrode removed from the holder.

14.3 Plasma arc cutting

14.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Ultra-violet radiation can cause eye damage.

b) Hot sparks can cause fires or burns to nearby articles, etc.

c) Articles being cut can release explosive vapours.

d) The equipment can present an electric shock hazard.

e) Leads and hoses could be tripped over.

f) Jewellery can conduct electricity that could induce heating and cause burns.

g) Toxic fumes could be generated by the cutting process.

14.3.2 Risk control measures

Users and observers of plasma arc cutting should be protected against glare and sparks by the use of appropriate goggles or shields. Surrounding surfaces should be painted black so that glare is not transmitted out of the immediate area of the cutter.

Users of plasma arc cutting equipment should ensure that they are wearing appropriate protective clothing covering all parts of their bodies. Where overalls are worn under heat resisting clothing they should be of a type that self-extinguishes. Users should ensure that any flammable articles are kept well away from any cutting operations.

The cutting up of tanks or any other closed containers should not be undertaken.

Care should be taken to ensure that trailing leads and hoses do not become entangled with the operator, the cutting equipment or others in the vicinity.

Jewellery should not be worn when plasma arc cutting.

Local exhaust ventilation should be provided to remove fumes.

Plasma arc cutting equipment should be included in a planned annual maintenance programme that should include any appropriate electrical safety tests.

14.4 Oxy-acetylene welding

NOTE 1 Under the Pressure Systems and Transportable Gas Containers Regulations 1989, a competent person is required to install gas pipes.

Warning signs "Beware compressed gas" and "Beware flammable material" conforming to BS 5499-5, should be displayed at entrances to workshops.

NOTE 2 Attention is drawn to Health and Safety (Safety Signs and Signals) Regulations 1996.

Only those oxygen and acetylene cylinders in current use should be kept in the workshop. These should be secured on a trolley in an upright position in a well-ventilated area away from combustible materials and having direct access to the outside of the building. It is important to have the correct trolley to ensure that it cannot be knocked over.

Cylinders should be treated with care. Cylinders should not be subjected to mechanical damage, falls or abnormal heat levels.

Acetylene cylinders contain liquid and should be kept with the valves uppermost.

Spare cylinders (full or empty) should be kept upright in a safe, secure, well-ventilated place outside the building. Cylinders should not be kept below ground level or next to drains, basements or other low-lying places.

It is essential that appropriate regulators, hoses, non-return valves, flame arresters and torches are used. Advice on these items should be obtained from a welding equipment supplier. Oil or grease should not be allowed to come into contact with oxygen regulator valves or fittings.

NOTE 3 Oil or grease in contact with oxygen regulator valves or fittings can spontaneously combust.

Risk of a welding flame "flash-back" into hoses or cylinders should be minimized by training users in the correct lighting up and working procedures and by fitting effective non-return valves and flame arresters.

Cylinder valves should be turned off after use. Cylinders should be changed in a well ventilated place away from sources of ignition.

Proprietary leak detecting fluids should be used to test for leaks from connections.

The equipment should be included in a planned maintenance programme that should include any appropriate electrical safety tests.

Oxy-acetylene equipment, where date-stamped, should be service-exchanged or replaced every five years.

14.5 Casting

14.5.1 Hazards

Employees and students should be aware of the following hazards.

a) Hot molten metal can present a hazard.

b) Molten metal in contact with moisture on moulds and equipment can cause an explosion.

c) A violent reaction can occur between molten aluminium and various metallic oxides [e.g. iron oxide (rust)].

d) Degassing tablets cause fumes that can be harmful if inhaled.

e) Some molten metals can give off harmful fumes.

f) Expanded polystyrene patterns can produce large quantities of harmful fumes when in contact with molten metal.

g) Manual handling of heavy, hot crucibles can present a hazard.

14.5.2 Risk control measures

Only equipment specifically intended for metal casting should be used. Safety tilt crucible furnaces should be used. Casting should only be carried out in a dry area.

LEV should be used.

Casting equipment should only be used under supervision of a competent teacher with training at least to the standard specified in the *Health and Safety Training Standards in Design and Technology* (published by the D & T Association), or who has equivalent recognized qualifications to industry standards.

All persons involved in pouring molten metal should wear personal protective equipment (substantial footwear, suitable eye protection, heat resistant gloves, spats and gaiters, leather apron).

Any persons not directly taking part in pouring hot metal should be kept at a safe distance.

Large-scale casting work should only be carried out on aluminium or zinc based alloys.

Aluminium alloys should not be melted in a plain iron pot.

If green sand is used, it is essential that the moisture content is kept to the minimum required to bond the sand. Oil-bonded sand should be used if possible.

Crucibles should be preheated before use to avoid cracking and to remove moisture. Equipment to be brought into contact with metal should be wire brushed, and preferably coated in a limestone refractory wash and thoroughly dried.

Casting equipment should be included in a planned annual maintenance programme that should include any appropriate electrical safety tests.

Boxes used for heat treatment should be of steel.

14.6 Low temperature casting

14.6.1 Hazards

Employees and students should be aware of the following hazards.

a) Molten metal in contact with moisture on moulds and equipment can cause an explosion.

b) Some molten metals can give off harmful fumes.

c) Expanded polystyrene patterns can produce large quantities of harmful fumes when in contact with molten metal.

d) Hot metal can cause burns.

e) Unstable equipment or work pieces can cause injury.

f) The equipment can present an electric shock hazard.

14.6.2 Risk control measures

Only equipment specifically intended for metal casting should be used. Casting should only be carried out in a dry area.

Casting equipment should only be used under supervision of a competent teacher with training at least to the standard specified in the *Health and Safety Training Standards in Design and Technology* (published by the D & T Association), or who has equivalent recognized qualifications to industry standards.

All persons involved in pouring molten metal should wear personal protective equipment (e.g. suitable eye protection, heat resistant gloves, leather apron, substantial footwear).

Any persons not directly taking part in pouring hot metal should be kept at a safe distance.

Crucibles and any other equipment that will be in contact with the molten material should be preheated before use to avoid cracking and to remove moisture.

Care should be taken to ensure that trailing leads are inspected regularly.

Casting equipment should be included in a planned annual maintenance programme that should include any appropriate electrical safety tests.

14.7 Centrifugal casting equipment

14.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Centrifugal casting requires considerable expertise to carry out and to supervise effectively.

b) Spillage or spray of molten metal can occur if the crucible or casting flask is poorly affixed, or if the crucible is cracked.

14.7.2 Risk control measures

Centrifugal casting equipment should be of sufficient strength to withstand rigorous service. The equipment should be confined to a robust fire-resistant container to minimize risk of spillage or spray of molten metal. Particular attention should be given to secure fixing of the crucible, the adjacent flask, and any connection between them.

Only specifically intended centrifugal casting equipment should be used.

Only a competent person trained to use the equipment, and who has a secure knowledge of the process and the associated hazards, should carry out centrifugal casting. Centrifugal casting should only be carried out in a specially designed heat treatment area.

Before use, crucibles should be closely examined for cracks, splits or broken coatings. Crucibles should be preheated before use. If the "lost-wax" process is used, care should be taken to ensure that all traces of wax are burnt out.

Appropriate personal protective equipment (based on a risk assessment) should be provided (e.g. full face and hand protection for the operator and observers of the process).

The equipment should not be moved while the material is still molten.

Casting equipment should be included in a planned annual maintenance programme that should include any appropriate electrical safety tests.

14.8 Vacuum and pressure casting equipment

Only a competent person trained to use the equipment should carry out vacuum and pressure casting of metals.

Equipment should be specifically for the purpose and operated in accordance with the manufacturer's instructions.

NOTE Attention is drawn to the Pressure Systems Safety Regulations 2000.

14.9 Heat-treatment ovens

14.9.1 Hazards

Employees and students should be aware of the following hazards:

a) hot surfaces;

b) electric shock;

c) gas leaks from furnaces or pipework, which can produce an explosive mixture with air;

d) fumes.

14.9.2 Risk control measures

Electric heat-treatment ovens should have a means of isolation (preferably a fused switch-disconnecter) on or adjacent to the equipment, controlled by a starter incorporating overload protection and a no-volt release.

Gas heat-treatment ovens should include a non-return valve in the gas supply line.

Heat-treatment ovens should only be used by a competent person trained to use the equipment.

Heat-treatment oven temperatures should be checked by a pyrometer.

Boxes used for heat treatment should be of steel.

LEV should be used where fumes are produced.

Personal protective equipment should be used.

Provision should be made to remove items from the heat-treatment oven with suitable lifting and transfer devices and for placing them in a safe position.

The heat-treatment oven should be included in a planned maintenance programme that includes safety inspections and tests.

15 Chemical processes for metals and fabrics

15.1 General

Chemicals are classed as harmful, irritant, toxic, corrosive, flammable or highly flammable. It is essential to use up-to-date information on hazards associated with chemicals. Employees and students should be aware of hazards associated with chemicals. Warning labels on bottles, supplier's hazard data sheets and model risk assessments from CLEAPSS should be consulted, and a risk assessment undertaken.

It is essential that proper control measures are applied to the use of chemicals in schools and similar establishments to minimize hazards. It is essential that appropriate personal protective equipment is provided and used by employees and students. Only chemicals required for immediate use should be kept in the work area (see **3.2** for recommendations for storage).

15.2 Electronic circuit board etching

15.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Ferric chloride [iron(III) chloride] is irritant and harmful.

b) Sodium persulfate is an oxidizing agent and an irritant.

WARNING. It is essential to avoid mixing ferric chloride with sodium persulfate as chlorine gas will be released. CLEAPSS recommends that the two chemicals should not be available together in a design and technology department.

15.2.2 Risk control measures for ferric chloride

It is essential that suitable eye protection and protective gloves are used when preparing ferric chloride [iron(III) chloride] solutions and emptying tanks. Skin contact should be avoided. If skin contact occurs, the solution should be washed off with plenty of water. If etching is carried out in bubble tanks, it is essential that the lids are fitted to contain any mist.

NOTE Guidance on disposal of used solutions is available from CLEAPSS.

15.2.3 Risk control measures for sodium persulfate

It is essential that suitable eye protection and protective gloves are used when preparing and disposing of sodium persulfate solutions. Crystals should be kept away from combustible materials and sources of heat. Solutions should not be stored in airtight containers as oxygen is released. When emptying tanks, it is essential that suitable eye protection and protective gloves are used. Skin contact should be avoided. If skin contact occurs, the solution should be washed off with plenty of water. If etching is carried out in bubble tanks, it is essential that the lids are fitted to contain any mist.

NOTE Guidance on disposal of used solutions is available from CLEAPSS.

15.3 Soft soldering

15.3.1 Hazards

Employees and students should be aware that fumes from rosin based fluxes are harmful, irritant and can cause respiratory sensitization.

NOTE 1 Rosin based solder flux fumes have a workplace exposure limit (WEL) of 0.15 mg·m^{-3} (15 min reference period) and 0.05 mg·m^{-3} (eight hour reference period). For rosin fumes (as an asthmagen) the COSHH Regulations 2002 (as amended) require employers to ensure that exposure by inhalation is reduced as far as reasonably practicable and in any case to below the WEL.

Use of lead based solders with a blow torch can result in the release lead fumes if temperatures exceeding 500 °C are reached.

NOTE Use of lead based solders with a soldering iron is not a significant hazard as they do not release lead vapour at temperatures below 500 °C. However, lead based solders are currently being phased out of products because of the environmental hazards they pose when the products are recycled.

15.3.2 Risk control measures

Under the COSHH Regulations 2002 (as amended), there is a duty to prevent exposure to hazardous substances, or, where that is not reasonably practicable, to control exposure. Non-rosin based fluxes should be used wherever possible. Where rosin based fluxes have to be used, a risk assessment on fume inhalation should be carried out and local exhaust ventilation provided as required.

When soldering is undertaken using a blow torch local exhaust ventilation will normally be required.

Instruction should be given on correct soldering procedures.

Suitable eye protection should be worn.

15.4 Vitreous enamelling

15.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Finely ground borosilicate glass (coloured by trace metallic compounds) is toxic and an irritant to the skin and eyes.

b) If an enamelled surface is reheated too quickly it can shatter and eject particles.

15.4.2 Risk control measures

Enamels should be lead free. Suitable eye protection should be used during heating and when surfaces are allowed to cool. Hands should be washed thoroughly after handling enamels.

15.5 Pickling (acid deoxidizing) and acid etching of metals

15.5.1 Hazards

Employees and students should be aware that concentrated acids are corrosive and some are oxidizing agents.

15.5.2 Risk control measures

Only a competent teacher or technician should prepare acid solutions. To dilute them, acids should be added to water (and not vice versa).

Suitable eye protection, substantial footwear and protective clothing should be worn during preparation and use of pickling and etching solutions. Fume control measures should be provided where required by risk assessment. Splashes of solutions on the skin should be washed off immediately with plenty of water. Acids should not be stored in open pickling baths. Acids should be securely stored such that they cannot be accessed by unauthorized persons when not in use. Hot metals should not be quenched in acids. A kit containing materials to absorb and neutralize spilt acid should be readily available.

If pickling or etching is only an occasional activity, or if it is carried out on a small scale, consideration should be given to conducting this activity in a science laboratory, where appropriate risk control measures are likely already to be in place.

15.6 Dyes

15.6.1 Hazards

Employees and students should be aware of the following hazards.

a) Some dyes might be carcinogenic.

b) Some dyes are classified as harmful or irritant to the skin and eyes.

c) Some reactive dyes can produce sensitization and allergic reactions.

15.6.2 Risk control measures

All dyes should be handled with care (although many do not present any significant risk to most users).

Extra care should be taken when handling harmful and/or irritant dyes, to prevent ingestion and to protect the skin and eyes.

NOTE 1 Dyes classified as carcinogenic are so classified on the basis of data obtained from studies on laboratory animals using high doses of the dye. If these dyes are used with the normal safety precautions that are taken when handling chemicals in the laboratory, there are unlikely to be long-term effects on the health of persons.

Persons can become sensitized to dyes so that subsequent exposure even to small doses can provoke an allergenic reaction. Contact can be through inhalation, ingestion or skin absorption. Very reactive dyes are most likely to trigger an allergic response. The procion MX range of dyes should not be used (procion HE dyes are safer).

NOTE 2 Solutions of dyes are safer to handle than solid dyes.

When preparing solutions of solid dyes, care should be taken to avoid raising any dust that could be inhaled, and to ensure that there is no skin or eye contact by using gloves and suitable eye protection. If very reactive dyes are used, it is essential that solutions are prepared in a fume cupboard.

Students should handle dyes in solution rather than as solids. Powdered dyes should not be used by students below year 9. Students below year 12 should only handle powdered dyes under close supervision.

WARNING. It is essential that students do not handle powder of very reactive dyes.

15.7 Mordants

15.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Iron(II) (ferrous) sulfate, potassium dichromate(VI) and tin(II) (stannous) chloride are classified as harmful.

b) Some dye fixatives (e.g. containing sodium silicate), and mordant solutions containing more than 0.5% potassium dichromate(VI), are classified as toxic and irritant to the eyes and skin. Potassium dichromate(VI) is classified as oxidizing, very toxic and dangerous for the environment.

15.7.2 Risk control measures

Care should be taken to prevent ingestion and to protect the skin and eyes from mordants classified as harmful and/or irritant (especially when preparing solutions).

Gloves and suitable eye protection should be worn at all times when using mordants and dye fixatives.

15.8 Testing fibres and fabrics

15.8.1 Hazards

Employees and students should be aware of the following hazards.

a) The following solutions are classified as corrosive:
   - hydrochloric acid (>25%);
   - nitric acid (>5%);
   - sodium chlorate(I) (>10%);
   - sodium hydroxide (>2%);
   - sulfuric acid (>15%);
   - zinc chloride.

b) The following solutions are classified as harmful:
   - ammonia solution;
   - iodine;
   - lead(II) ethanoate;
   - propanone;
   - nail varnish remover.

c) The following solutions are classified as irritant to skin and eyes:
   - ammonia solution;
   - iodine solution;
   - soda lime;
   - sodium chlorate(I) (5% to 10%).

15.8.2 Risk control measures

Many tests on fibres and fabrics present a high level of risk. These tests should not be carried out unless proper facilities are available for working with chemicals. All persons carrying out tests on fibres and fabrics should be fully aware of the risks, the safety precautions required, and the action to be taken in case of accidents.

Special care should be taken when preparing solutions for tests. When preparing acid solutions, it is essential always to add the acid to water (and not vice versa). It is essential that suitable eye protection (face shield or goggles) is worn.

When investigating samples of fibres or fabrics, only very small quantities of materials and chemicals should be used. If fabrics are to be burned, the tests should be performed in a well-ventilated room using only minute amounts of material. It is essential that different chemicals are not used together, unless required by the test method.

It is essential that gloves are worn when corrosive or irritant solutions are handled or dispensed, unless only very small quantities are used when treating fabrics on a test-tube scale. Persons with sensitive skin, or who have cuts or abrasions, should wear gloves at all times.

Tests on fibres and fabrics should not be carried out by students below year 9. Students below year 12 should not carry out tests with corrosive chemicals.

WARNING. Trichloromethane (chloroform) is very dangerous by skin absorption, the vapour irritates the eyes, and short-term exposure to high concentrations can cause serious or even fatal poisoning.

Trichloromethane should not be used for tests on fibres and fabrics.

15.9 Cleaning fibres and fabrics

15.9.1 Hazards

Employees and students should be aware of the following hazards.

a) Tetrachloromethane (carbon tetrachloride) and trichloromethane are toxic and should not be used as cleaning agents.

b) Ammonia solution, methylated spirit, propanone, turpentine and 1,1,1-trichloroethane are harmful.

c) Ammonia solution and sodium chlorate(I) (5% to 10% solutions) (bleach) are irritant to the eyes and skin.

d) Ethanol, methylated spirit and propanone are highly flammable.

e) Enzymes in clothes-washing powders or liquids can cause sensitization and/or allergic reactions. Washing powders and soaking agents can cause skin irritation.

15.9.2 Risk control measures

It is essential that highly flammable solvents are not used near naked flames or other sources of ignition such as hot plates.

White spirit is harmful if swallowed. Ethanol vapour should not be inhaled. Methanol and methylated spirit [especially mineralized (blue) methylated spirit] are poisonous and should not be ingested.

Sodium chlorate(I) (bleach) can be irritant or corrosive depending on the concentration. Suitable eye protection should be worn and hands should be protected from contact with the solution.

16 Computer-operated equipment

16.1 Laser cutters

16.1.1 Hazards

Employees and students should be aware of the following hazards.

a) The equipment can present an electric shock hazard.

b) Leads could be tripped over.

c) Fumes from materials being cut might be harmful.

d) Looking into the light source when working on reflective materials might be harmful.

e) Moving parts might present a tripping hazard.

16.1.2 Risk control measures

The manufacturer's specific instructions for the particular machine being used should be followed. Care should be taken to ensure that leads are in good condition and are positioned to prevent tripping or snagging.

A risk assessment should be made when cutting materials that might give off toxic fumes. It is essential that local exhaust ventilation is provided.

If there is any chance of the laser beam being reflected into the view of any person in the vicinity of the machine, a cover should be placed over the viewing area of the cutter. Care should be taken to ensure that the correct power of laser is being used for the material being etched or cut.

Care should be taken to ensure that the cutter has all covers or guards in place.

16.2 Rapid prototyping including 3D printers, stereolithography (SLA), laser sintering, laminated object manufacture (LOM)

16.2.1 Hazards

Employees and students should be aware of the following hazards:

a) closing movements between parts under power feed, which can present a trapping hazard;

b) heat, which can be involved in some processes;

c) lasers;

d) the nature of the material used to form the prototype;

e) post-build curing processes.

16.2.2 Risk control measures

The manufacturer's specific instructions for the particular machine being used should be followed.

The machine should be guarded by interlocked guards that prevent access whilst the process is ongoing.

Models should be allowed to cool sufficiently to allow safe handling. Heat resistant gloves to might be needed to remove the model from the machine.

Shields and guarding should be appropriate to the class of laser.

Some polymer models might be toxic and should not be sucked or chewed.

NOTE In the case of powders, attention is drawn to the COSHH Regulations 2002 (as amended) for rules for handling the particular product.

Post-build curing processes should be risk assessed.

16.3 Rapid prototyping (printing) machines

16.3.1 Hazards

Employees and students should be aware of the following hazards.

a) electric shock;

b) leads, which could be tripped over;

c) fumes;

d) toxic materials;

e) the ultraviolet light source.

16.3.2 Risk control measures

Care should be taken to ensure that leads are in good condition and are positioned to prevent tripping or snagging.

A risk assessment should be undertaken if the machine being used produces toxic fumes. If found to be necessary, local exhaust ventilation should be provided.

A risk assessment should be undertaken if the material that the printer lays down is toxic. Appropriate measures should be undertaken when handling products produced by the printer, if the risk assessment indicates a significant risk.

Care should be taken to ensure that the printer is used in accordance with manufacturer's instructions and that all covers are in place when it is in operation.

16.4 Computer numerically controlled (CNC) machines

16.4.1 General

CNC machines generally have the same risks associated with them as their manual equivalents. However, they are generally safer in operation because most CNC machines used in education are fully enclosed, with opening doors that are interlocked in such a way that the machine stops if the door is opened whilst the machine is operating under computer control.

In setting up the machines, there are times when it might be possible for the machine to be operated manually, in which case similar care should be taken to that needed for manually operated machines.

16.4.2 CNC controlled routers

16.4.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Contact with revolving cutters can present a hazard.

b) Long hair, loose clothing, etc., can become entangled with rotating cutters or arbors.

c) Broken cutters, waste, work pieces, etc., can be violently ejected.

d) Wood dust can be inhaled.

e) Closing movement between parts, under power feed, can result in finger trapping.

f) Closing movement between the table and fixed structures can result in body crushing.

g) Heavy objects such as vices and jigs or fixtures can fall from the table.

h) CNC routing machines can present an electric shock hazard.

i) Sharp edges on cutters, work pieces and swarf can cause cuts.

j) Inadvertent starting of the machine can present a hazard.

k) Lack of space around the machine can lead to the operator being pushed by passers-by.

l) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

m) Manual handling of heavy equipment such as vices and index fixtures can present a hazard.

16.4.2.2 Risk control measures

The manufacturer's specific instructions for the particular machine being used should be followed.

It is essential that the machine is provided with:

- a means of electrical isolation adjacent to the machine;
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards, that enclose the drive pulleys, belts and gears.

Care should be taken to ensure that the work piece is properly secured.

Guards should be used to prevent access to dangerous in-running nips on the pulleys or gearwheels. Cutters should be guarded while in motion to prevent access. Ends of rotating arbors should be fitted with guards to prevent entanglement.

Where not enclosed, CNC routing machines should be fitted with a space of at least 500 mm between the machine table at the extreme ends of its travel and any fixed object.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

It is essential that suitable eye protection is used while operating the machine, if the machine is not totally enclosed, and also when cleaning the machine.

Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

A risk assessment should be carried out to evaluate the likely risks to health from inhalation of wood dust and any action required to prevent or control the risks. Normally LEV should be used (see **10.1**).

Manual handling tasks associated with moving heavy work pieces, vices and jigs and fixtures can be beyond the physical capability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated, or the computer programme should be stopped, before any internal mechanisms are adjusted. It is essential that the cutters are stopped when positioning the work piece, clearing waste, measuring or gauging.

Hands should be kept away from the table while it is traversing under power in manual mode to minimize the risk of trapping fingers.

Suitable implements should be used to remove waste, to avoid hand contact.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

16.4.3 CNC controlled centre lathes

16.4.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Long hair, loose clothing, etc., can become entangled in moving parts of the lathe.

b) Work pieces, chuck keys, broken cutting tools, swarf, etc., can be violently ejected from the lathe.

c) CNC centre lathes can present an electric shock hazard.

d) Closing movements between parts under power feed can present a trapping hazard.

e) Sharp edges on tools, work pieces and swarf can cause cuts.

f) Contact with cutting fluids, oil and grease can irritate the skin.

g) Swarf can jam or be ejected if allowed to build up.

h) Inadvertent starting of the machine can present a hazard.

i) Lack of space around the machine can lead to the operator being pushed by passers-by.

j) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

k) Manual handling (lifting) of heavy equipment (e.g. chucks, faceplates) can present a hazard.

16.4.3.2 Risk control measures

The manufacturer's specific instructions for the particular machine being used should be followed. It is essential that the machine is provided with:

- a means of electrical isolation adjacent to the machine;

- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards that enclose the drive mechanisms.

The machine should be fitted with suitable guarding. If feed shafts or lead screws are outside of the guarded areas and are not sufficiently protected by the overhang of the bedways and/or saddle and swarf trays, a telescopic helical metal guard should be provided.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items and swarf.

Only one person at a time should operate the machine.

It is essential that suitable eye protection is used while operating the machine, if the machine is not totally enclosed, and also when cleaning the machine.

Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Manual handling tasks associated with changing heavy chucks and faceplates, etc., can be beyond the physical ability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated or the computer programme should be stopped before any internal mechanisms are adjusted. The power to drive feed shafts or lead screws should be disconnected until required. The chuck key, preferably spring-loaded, should be removed immediately after use and before starting the machine.

Care should be taken to ensure that work mounted to a faceplate, a chuck or between centres is properly secured and balanced to prevent excessive vibration. The rotational clearance should be checked by hand before starting the machine. The cutting tool should also be carefully checked for security before starting the machine.

Stock bar should not project beyond the headstock. If this is unavoidable, the portion of stock bar projecting beyond the headstock should be guarded to prevent entanglement.

Coolant nozzles should not be adjusted while the machine is in operation.

The machine should be stopped when measuring or gauging, and the cutting tool positioned to minimize possible contact.

Swarf should not be allowed to accumulate as it can become entangled or ejected by the chuck or work piece. Swarf should not be removed while the machine is operating. A suitable implement should be used to avoid hand contact with swarf.

Metalworking fluids, if used, should be mixed and changed in accordance with the supplier's instructions. Contact with the skin should be kept to a minimum. Hands should be washed thoroughly after use.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

16.4.4 CNC controlled milling machines or machining centres, and engraving machines

16.4.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Contact with revolving cutters can present a hazard.

b) Long hair, loose clothing, etc., can become entangled with rotating cutters or arbors.

c) Broken cutters, swarf, work pieces, etc., can be violently ejected.

d) Closing movement between parts, under power feed, can result in finger trapping.

e) Closing movement between the table and fixed structures can result in body crushing.

f) Heavy objects such as vices and jigs and fixtures can fall from the table.

g) CNC milling machines can present an electric shock hazard.

h) Sharp edges on cutters, work pieces and swarf can cause cuts.

i) Contact with cutting fluids, oils and greases can irritate the skin.

j) Inadvertent starting of the machine can present a hazard.

k) Lack of space around the machine can lead to the operator being pushed by passers-by.

l) Slippery floor surfaces or loose items around the machine can cause slips that result in contact with moving parts.

m) Manual handling of heavy equipment such as vices and index fixtures can present a hazard.

16.4.4.2 Risk control measures

The manufacturer's specific instructions for the particular machine being used should be followed. It is essential that the machine is provided with:

- a means of electrical isolation immediately adjacent to the machine.
- a conveniently positioned, mushroom-headed stop button or other suitable control device that can quickly stop the machine in an emergency;
- fixed guards (removable only with the use of a tool), or alternatively interlocked guards, that enclose the drive pulleys, belts and gears.

Care should be taken to ensure that the work piece is properly secured.

Guards should be used to prevent access to dangerous in-running nips on the pulleys or gearwheels. Cutters should be guarded while in motion to prevent access. Ends of rotating arbors should be fitted with guards to prevent entanglement.

Where not enclosed, CNC milling machines or machining centres should be fitted with a space of at least 500 mm between the machine table at the extreme ends of its travel and any fixed object.

There should be sufficient space around the machine to prevent the operator from being accidentally pushed by passers-by. The floor surface should not be slippery and should be kept free of loose items.

It is essential that suitable eye protection is used while operating the machine, if the machine is not totally enclosed, and also when cleaning the machine.

Substantial footwear should be worn.

Long hair and loose clothing should be secured so as not to come into contact with moving parts. Dangling jewellery should be removed. Gloves should not be worn.

Manual handling tasks associated with moving heavy work pieces, vices and indexing heads can be beyond the physical capability of some persons. An assessment should be carried out and measures implemented to minimize risks associated with lifting heavy items (e.g. use of lifting aids, team lifts, correct lifting techniques).

The machine should be electrically isolated or the computer programme should be stopped before any internal mechanisms are adjusted. It is essential that the machine and cutters are stopped when positioning the work piece, clearing swarf, adjusting coolant hoses, measuring or gauging.

Hands should be kept away from the table while it is traversing under power to minimize the risk of trapping fingers.

Suitable implements should be used to remove swarf to avoid hand contact.

If metalworking fluids are used, they should be mixed and changed in accordance with the supplier's instructions. Contact with the skin should be kept to a minimum. Hands should be washed thoroughly after use.

The machine should be included in a planned maintenance programme that should include electrical safety inspections and tests.

Section 5: Materials

17 Materials

NOTE The Control of Substances Hazardous to Health Regulations 2002 (as amended) require that a full assessment of risks to health and any steps required to eliminate or control these risks is carried out. Control measures have to be put into effect before any hazardous substances are used.

17.1 Materials data sheets

NOTE It is a legal requirement under the COSHH Regulations 2002 (as amended) for the supplier of a material to provide information about associated hazards.

Employees should ensure, for materials for which this is relevant, that current material data sheets are available and that the control measures given are followed.

17.2 Asbestos and products containing asbestos

17.2.1 Hazards

Employees and students should be aware that asbestos dust and fibres can be inhaled.

17.2.2 Risk control measures

It is essential that asbestos containing materials are not used. All fire blankets, mats, gloves, ropes, wools, fillers, cement and brake/clutch linings should be asbestos free.

NOTE 1 The Control of Asbestos Regulations 2006 require employers to assess the likely exposures to asbestos and to ensure that concentrations of airborne asbestos fibres do not exceed strict exposure limits. Advice from specialists should be sought. In some cases it is required that the HSE are notified before work with asbestos containing materials can be carried out.

NOTE 2 If any asbestos is present in the department it is a requirement under the Control of Asbestos Regulations 2006 for this to be included in the establishment's asbestos management plan.

17.3 Adhesives

17.3.1 General

17.3.1.1 Hazards

Employees and students should be aware of the following hazards.

a) Adhesives in contact with the eyes can cause permanent injuries.

b) Adhesives in contact with the skin can cause irritation. Some adhesives are toxic by absorption through the skin. Hot adhesives can cause burns.

c) Inhalation of solvents, fumes and vapours can present a hazard and can cause respiratory sensitization.

d) Adhesives containers can spill or leak.

e) Adhesives vapours can be highly flammable.

17.3.1.2 Risk control measures

Adhesives should be used in accordance with the manufacturer's instructions.

Sufficient ventilation should be provided, in accordance with the manufacturer's recommendations.

NOTE Under the COSHH Regulations 2002 (as amended), a risk assessment needs to be carried out.

Local exhaust ventilation should be provided if required.

Non-hazardous or reduced-hazard alternatives should be used in preference to adhesives that carry the risk of respiratory sensitization.

17.3.2 Formaldehyde resins

17.3.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Formaldehyde resins release toxic fumes, but at very low concentration.

b) Inhalation of unmixed powder can present a hazard.

c) Formaldehyde resins can irritate the eyes and skin.

d) Some formaldehyde resins are highly flammable.

e) Formaldehyde resins are a skin sensitizer.

f) Liquid hardener can be corrosive.

17.3.2.2 Risk control measures

A safer substitute should be used if available.

Formaldehyde resins should be used in accordance with the manufacturer's instructions. Sufficient ventilation should be provided.

Protective gloves or a barrier cream should be used.

Dust release should be kept to a minimum when mixing powder.

Formaldehyde resins should be stored in appropriate containers. Containers should be closed when not in use.

17.3.3 Epoxy and polyester resins

17.3.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Epoxy and polyester resins are hazardous if ingested or absorbed through the skin.

b) Vapour and dust can irritate the eyes and skin. Resins can be a cause of dermatitis.

c) Dust from machining fully cured resin can irritate the eyes, nose, throat and lungs.

d) Epoxy resins can produce highly flammable vapours.

17.3.3.2 Risk control measures

Epoxy and polyester resins should be stored in securely closed containers. Care should be taken to prevent leakage.

Sufficient ventilation should be provided. All sources of ignition should be removed.

Epoxy and polyester resins should not be allowed to come into contact with the eyes or skin. Protective gloves should be worn.

Suitable eye protection and respiratory protective equipment should be worn during machining and shaping of cured resins.

17.3.4 Cyanoacrylate adhesives ("superglues")

17.3.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Cyanoacrylate adhesive vapours can irritate the skin and nasal passages.

b) Cyanoacrylate adhesives can rapidly bond skin.

17.3.4.2 Risk control measures

A safer substitute should be used if available.

Proper instruction should be given on use of cyanoacrylate adhesives.

Sufficient ventilation should be provided.

Suitable eye protection should be worn. A barrier cream should be used on hands.

17.3.5 Solvent-based rubber solutions and polymer cements

17.3.5.1 Hazards

Employees and students should be aware of the following hazards.

a) Solvent-based rubber solutions and polymer cements produce highly flammable vapours.

b) Inhalation of vapours can be harmful.

c) Solutions can irritate the skin and eyes.

17.3.5.2 Risk control measures

A safer substitute should be used if available.

Sufficient ventilation should be provided.

All sources of ignition should be removed.

Suitable eye protection should be worn.

17.3.6 Rubber-based and water-based adhesives

17.3.6.1 Hazards

Employees and students should be aware that rubber-based and water-based adhesives can cause allergic reactions.

17.3.6.2 Risk control measures

Rubber-based and water-based adhesives should not come into contact with eyes and skin.

17.3.7 Acrylic cement

17.3.7.1 Hazards

Employees and students should be aware of the following hazards.

a) Inhalation of acrylic cement vapour can present a hazard. Vapours can irritate the eyes, skin and respiratory tract.

b) Methyl methacrylate is a respiratory sensitizer.

c) Acrylic cement vapour is flammable and potentially explosive in air.

17.3.7.2 Risk control measures

A safer substitute should be used if available.

Acrylic cement should be refrigerated prior to use.

Sufficient ventilation should be provided.

Suitable eye protection should be worn. Students with sensitive skin should wear gloves.

Acrylic cement should only be used for a short time, depending on the level of ventilation. Only an appropriate amount of acrylic cement should be used for each application. Work should be carried out well away from any source of ignition.

17.3.8 Hot melt glue using glue guns

Guidance on the use of glue guns is given in **9.13**.

17.4 Plastics

17.4.1 General

NOTE 1 The COSHH Regulations 2002 (as amended) require a suitable risk assessment to be carried out before plastics materials are used.

It is essential that manufacturer's instructions and warnings associated with plastics materials and items of equipment are complied with. Unidentified plastics materials should not be used.

Care should be taken if working on brittle plastics sheet material. Taping and safe handling techniques should be used to avoid shattering.

Many plastics materials produce dust and other fine particles when machined or abraded. Persons suffering from asthmatic conditions are at increased risk from the health hazards arising from abrading of plastics materials. Hand methods of abrading should be preferred over machining, and water should be used as a lubricant where practicable.

Sufficient ventilation should be provided. It is essential that concentrations of vapours from solvents and cement are kept to a minimum. A risk assessment should be carried out and local exhaust ventilation provided if required.

NOTE 2 In many cases there can be a delayed reaction to inhalation of toxic vapours in the work area. Ventilation should be provided at a rate of six to eight air changes per hour.

Plastics materials should be stored in cool, dry conditions. Stocks of plastics materials should not exceed the quantities required for three months.

17.4.2 Acrylic and other thermoplastics materials

17.4.2.1 Hazards

Employees and students should be aware of the following hazards.

a) Dust from hand and machine cutting and shaping of acrylic and other thermoplastics materials can irritate the eyes, nose and throat. Inhalation of dust can present a hazard.

b) Heat softened plastics can stick to skin.

c) Work pieces can shatter during machining.

17.4.2.2 Risk control measures

Sufficient ventilation should be provided.

If possible, water should be used as a lubricant to minimize dust.

Suitable eye protection and respiratory protective equipment should be worn during machining. Gloves should be used if work pieces are heat softened.

Work pieces should be securely clamped during machining.

17.4.3 Expanded polystyrene

17.4.3.1 Hazards

Employees and students should be aware of the following hazards.

a) Overheated expanded polystyrene can produce fumes.

b) Dust or solid pieces can irritate the eyes.

c) Inhalation of dust can irritate the upper respiratory tract.

17.4.3.2 Risk control measures

A safer substitute should be used if available.

Hot wire cutters should be used at the lowest temperature practicable, and a risk assessment made to determine the level of ventilation required.

Sufficient ventilation should be provided.

17.4.4 Rigid polyurethane foam

17.4.4.1 Hazards

Employees and students should be aware of the following hazards.

a) Heated rigid polyurethane foam produces hazardous fumes.

b) Dust from abrading can present a hazard.

17.4.4.2 Risk control measures

Hot wire cutters should not be used to cut rigid polyurethane foam.

Sufficient ventilation should be provided.

Suitable eye protection should be used during abrading or cutting rigid polyurethane foam.

17.4.5 Glass reinforced polyester (GRP) resin

17.4.5.1 Hazards

Employees and students should be aware of the following hazards.

a) Polyester resin and glass reinforced polyester resin can produce fumes until fully cured. Fumes are flammable and can irritate the eyes and respiratory system.

b) Very high concentrations of vapour can build up in confined spaces (e.g. inside a canoe).

c) Resins degrease the skin and prolonged contact can cause dermatitis.

d) Catalysts in resins are very irritating to the eyes, throat and upper respiratory system. Prolonged contact with the eyes causes permanent damage.

e) Catalysts and accelerators can react violently or explode if mixed.

17.4.5.2 Risk control measures

Sufficient ventilation should be provided. Local exhaust ventilation should be used if required. Work should not be carried out near to sources of ignition.

Not more than 1 m^2 of laid up material should be in the work area at any time. Not more than 0.25 kg of casting resin should be used at any time. Laying up should not be carried out at floor level.

Resins should be of the pre-accelerated type. Catalysts and accelerators should not be mixed together directly. Calibrated dispensers should be used. Only a competent teacher or technician should dispense these materials.

Suitable eye protection and protective gloves should be worn.

17.5 Timber

17.5.1 Hazards

Employees and students should be aware of the following hazards.

a) Wood dust irritates the eyes and respiratory tract.

b) High exposure to wood dust can cause skin, lung and nasal disorders and, rarely, cancer.

c) High concentrations of fine wood dust in the air can form an explosive mixture.

d) Wood dust accumulated on surfaces is a fire hazard.

e) Wood dust on the floor of the work area can be slippery.

f) Brushing can create airborne dust.

g) Handling heavy samples can be hazardous.

17.5.2 Risk control measures

NOTE 1 The Control of Substances Hazardous to Health Regulations 2002 (as amended) require a risk assessment to be carried out on wood dust to determine the control measures required. A combination of control measures night be required.

NOTE 2 Regular users of timber materials (especially if sanding is regularly carried out) are at increased risk of cumulative hazards to their nasal and upper respiratory passages. The degree of risk depends on the dust concentration and the length of exposure.

All timber-based dusts are assigned with an HSE maximum workplace exposure limit (WEL) of 5 $mg \cdot m^{-3}$, and control measures should be put in place to reduce exposure to the lowest reasonably practicable level.

It is essential that sufficient general ventilation is provided. A risk assessment should be carried out, and local exhaust ventilation provided if required.

Respiratory protective equipment should be provided if required.

Machine sanding should be kept to a minimum.

Respiratory protective equipment should be worn during any prolonged hand or machine sanding. Suitable eye protection should be worn.

Work areas (including floors) should be kept clean using a vacuum cleaner with high efficiency particle arrestance (HEPA) air filters.

17.6 Metals

*NOTE The recommendations given in **17.6.1** and **17.6.2** apply to commonly used metals in design and technology work areas.*

17.6.1 Hazards

Employees and students should be aware of the following hazards.

a) Waste materials from processing metals can damage the eyes and skin.

b) Coolants and cutting oils can irritate the eyes and can cause dermatitis.

c) Falling materials can present a hazard.

17.6.2 Risk control measures

Proper instruction should be given on safe handling of metals and metal waste.

Suitable eye protection should be worn when machining metals. Hands should be washed thoroughly after contact with metals and coolants.

17.7 Food and food components

17.7.1 General

Teachers, technicians and supervisors using food or food components in design and technology or home economics teaching should be competent in food hygiene. As a minimum qualification, a recognized food safety certificate should be held and, preferably, the relevant qualification from the *Health and Safety Training Standards in Design and Technology* (published by the D & T Association). All teachers and supervisors handling food should be aware of the requirements of the Food Safety Act 1990, the Food Safety (Temperature Control) Regulations 1995 and the Food Safety (General Food Hygiene) Regulations 1995.

NOTE These regulations do not apply to food technology departments in schools unless the food is for sale.

17.7.2 Hazards

Employees and students should be aware of the following hazards:

a) fungi, bacteria and viruses, which can cause food poisoning;

b) poor personal hygiene;

c) inappropriate storage areas or temperatures;

d) inappropriate food preparation areas;

e) inappropriate clothing;

f) cross contamination;

g) inadequate cleaning;

h) waste food.

17.7.3 Risk control measures

Hands should always be washed before handling food. Sick or ill students should not handle food or food components.

Appropriate, clean and hygienic clothing should be worn. Cuts and sores should be covered.

Care should be taken to ensure that cooked and raw foods are kept separate.

Food should be kept clean, covered and either hot or cold.

Food should always be stored at the appropriate temperature (see **3.2.3**).

Care should be taken to ensure that food handling areas are kept clean at all times and that all tools and equipment are clean before use.

Waste food should be stored and disposed of appropriately.

Hazard analysis and critical control points (HACCP) should be applied as appropriate.

17.8 Fabric and fibres

17.8.1 Hazards

Employees and students should be aware of the following hazards:

a) inappropriate storage of fabrics and fibres;

b) needles, pins and other sharp implements;

c) testing of fabrics, which can produce harmful fumes;

d) dyes, mordants, paints, and inks;

e) materials which can cause irritation.

17.8.2 Risk control measures

Care should be taken to ensure that all fabrics and fibres are stored appropriately and away from any sources of ignition and that all waste bins are regularly emptied.

An appropriate risk assessment should be made prior to using dyes, mordants, paints, and inks.

Care should be taken when using needles, pins, unpickers, and any other sharp implements.

Section 6: Terms and definitions, and references

18 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

18.1 extra-low voltage
voltage normally not exceeding 50 V a.c. or 120 V ripple free d.c., whether between conductors or to earth [BS 7671:2001]

18.2 separated extra-low voltage
SELV
extra-low voltage system which is electrically separated from earth and from other systems in such a way that a single fault cannot give rise to the risk of electric shock [BS 7671:2001]

NOTE 1 A separated extra-low voltage source can be:

- *a class II safety isolating transformer conforming to BS EN 61558, with the secondary winding isolated from earth;*
- *a source of current that provides a degree of safety equivalent to that of the safety isolating transformer above (e.g. a motor generator with windings that provide equivalent isolation);*
- *an electro-technical source (e.g. a battery);*
- *a source independent of a higher voltage circuit (e.g. a diesel-driven generator);*
- *an electronic device designed so that the voltage at the outgoing terminals cannot exceed 50 V a.c. or 120 V d.c. if there is an internal fault.*

NOTE 2 For details of the arrangements of circuits see BS 7671:2001, Chapter 41.

18.3 low voltage
voltage normally exceeding extra-low voltage but not exceeding 1 000 V a.c. or 1 500 V d.c. between conductors, or 600 V a.c. or 900 V d.c. between conductor and earth [BS 7671:2001]

NOTE Low voltage includes mains voltage.

18.4 switch-disconnector
switch which, in the open position, satisfies the isolating requirements specified for a disconnector [BS EN 60947-3:1999, **2.3**]

18.5 fused switch-disconnector
switch-disconnector in which one or more poles have a fuse in series in a composite unit

*NOTE 1 See BS 60947-3:1999, **2.9**, definition of "switch-disconnector-fuse".*

NOTE 2 Fused switch-disconnectors are also called switched or fused isolators.

18.6 residual current device
mechanical switching device or association of devices intended to cause the opening of the contacts when the residual current attains a given value under specified conditions [BS 7671:2001]

18.7 ingress protection (IP) rating
indication of degree of protection against liquids and solids ingress into electrical equipment

*NOTE See BS EN 60529:1992, **3.4**, definition of "IP code".*

19 References

19.1 General

The references in **19.2** to **19.5** provide specific guidance on areas related to this British Standard code of practice. If a specific reference is not provided to any item covered by this British Standard code of practice, this does not necessarily mean that none is available. No guarantee can be given that any publication will be available at any time.

19.2 Government publications

Available from The Stationery Office, TSO Orders/Post Cash Department, PO Box 29, Norwich, NR3 1GN.

a) Regulations publications.

Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (as amended).

Control of Asbestos Regulations 2006.

Control of Noise at Work Regulations 2005.

Control of Substances Hazardous to Health Regulations 2002 (as amended).

Control of Vibration at Work Regulations 2005.

Dangerous Substances and Explosive Atmospheres Regulations 2002.

Disability Discrimination Act 1995.

Electricity at Work Regulations 1989.

Electricity Supply Regulations 1988 (as amended).

Electrical Equipment (Safety) Regulations 1994.

Environmental Protection Act 1990.

Fire (Scotland) Act 2005.

Fire and Rescue Services (Northern Ireland) Order 2006.

Food Hygiene (England) Regulations 2005.

Food Premises (Registration) Regulations 1991 (as amended).

Food Safety Act 1990.

Food Safety (Temperature Control) Regulations 1995.

Food Safety (General Food Hygiene) Regulations 1995.

Food Labelling Regulations 1996.

Gas Act 1985.

Gas Act 1995.

Gas Safety (Installation and Use) Regulations 1998.

Health and Safety (Display Screen Equipment) Regulations 1992.

Health and Safety (First Aid) Regulations 1981.

Health and Safety (Safety Signs and Signals) Regulations 1996.

Health and Safety at Work etc. Act 1974.

Lifting Operations and Lifting Equipment Regulations 1998.

Management of Health and Safety at Work Regulations 1999.

Manual Handling Operations Regulations 1992.

Personal Protective Equipment at Work Regulations 1992.

Plugs and Sockets etc. (Safety) Regulations 1994.

Pressure Systems Safety Regulations 2000.

Pressure Systems and Transportable Gas Containers Regulations 1989.

Provision and Use of Work Equipment Regulations 1998.

Regulatory Reform (Fire Safety) Order 2005.

Reporting of Injuries Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995.

Supply of Machinery (Safety) Regulations 1992 (as amended).

Schools (Scotland) Code 1956.

NOTE Published by the Scottish Executive.

Secondary School (Grant Conditions) Regulations (Northern Ireland) 1973.

Workplace (Health, Safety and Welfare) Regulations 1992.

b) Guides and information.

Fire Safety Risk Assessment – Educational Premises 2006.

c) Department for Education and Skills publications.

DfES *Managing School Facilities. Guide 6, Fire Safety.*

DfES (1995), *A Guide to Safe Practice in Art and Design.*

DfES (1996), *Building Bulletin 7: Fire and the Design of Educational Buildings.*

DfES (2004), *Building Bulletin 81: Design and Technology Accommodation in Secondary Schools.*

DfES (2004), *Building Bulletins 98 and 99: Area Guidelines for Schools.*

DfES (1996), *Safety in Science Education.*

DfES (1998), *Guidance on First Aid for Schools.*

d) Department of Education – Northern Ireland publications.

Publication No. 2004/5 *Class sizes in practical subjects in post-primary schools.*

19.3 HSE publications

The following Health and Safety Executive Publications can be obtained from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA.

HSG 17, *Safety in the Use of Abrasive Wheels.*

HSG 37, *An Introduction to Local Exhaust Ventilation.*

HSG 39, *Compressed Air Safety.*

HSG 42, *Safety in the Use of Metal Cutting Guillotines and Shears*.

HSG 53, *Respiratory Protective Equipment at Work: A Practical Guide.*

HSG 54, *The Maintenance, Examination and Testing of Local Exhaust Ventilation.*

HSG 67, *Health and Safety in Motor Vehicle Repair.*

HSG 103, *Safe Handling of Combustible Dusts: Precautions Against Explosions.*

HSG 107, *Maintaining Portable and Transportable Electrical Equipment.*

HSG 118, *Electrical Safety in Arc Welding.*

HSG 129, *Health and Safety in Engineering Workshops.*

PM 38, *Selection and Use of Electric Handlamps.*

PM 44, *Drilling Machines: Guarding of Spindles and Attachments.*

L5, *Control of Substances Hazardous to Health (Fifth Edition): The Control of Substances Hazardous to Health Regulations 2002 (as amended) Approved Code of Practice and Guidance*, 2005.

L21, *Management of Health and Safety at Work. Management of Health and Safety at Work Regulations 1999 Approved Code of Practice and Guidance*, 2000.

L22, *Safe Use of Work Equipment. Provision and Use of Work equipment Regulations 1998 Approved Code of Practice and Guidance*, 1998.

L23, *Manual Handling: Manual Handling Operations Regulations 1992 (as amended). Guidance on Regulations*, 2004.

L24, *Workplace Health, Safety and Welfare. Workplace (Health, Safety and Welfare) Regulations 1992 (as amended by the Quarries Miscellaneous Health and Safety Provisions Regulations 1995). Approved Code of Practice and Guidance*, 1996.

L25, *Personal Protective Equipment at Work (Second Edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations*, 2005.

L26, *Work with Display Screen Equipment. Health and Safety (Display Screen Equipment) Regulations 1992 as amended by the Health and Safety (Miscellaneous Amendments) Regulations 2002 Guidance on Regulations*, 2003.

L56, *Safety in the Installation and Use of Gas Systems and Appliances. Gas Safety (Installation and Use) Regulations 1998. Approved Code of Practice and Guidance*, 1998.

L64, *Safety Signs and Signals. Health and Safety (Safety Signs and Signals) Regulations 1996. Guidance on Regulations*, 1996.

L73, *A Guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations*, 1995.

L74, *First Aid at Work. Health and Safety (First Aid) Regulations 1981. Approved Code of Practice and Guidance*, 1997.

L113, *Safe Use of Lifting Equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved Code of Practice and Guidance*, 1998.

L114, *Safe Use of Woodworking Machinery. Provision and use of Work Equipment Regulations 1998 as applied to Woodworking Machinery. Approved Code of Practice and Guidance*, 1998.

ESAC, *Safety Policies in the Education Sector*, 1994.

ESAC, *Health and Safety Guidance for School Governors and Members of School Boards*, 1998.

EDIS 2 REV1, *Preventing slip and trip incidents in the education sector*.

INDG 163 REV2, *Five Steps to Risk Assessment*.

HSE 31 REV1, *RIDDOR Explained: Reporting of Injuries, Diseases and Dangerous Occurrences Regulations*, 1999.

EH40/2005, *Workplace Exposure Limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulation 2002 (as amended)*.

19.4 Other publications

a) Department for Communities and Local Government publications, PO Box 236, Wetherby LS23 7NB.

Fire Safety Risk Assessment – Educational Premises, 2006.

b) Chartered Institution of Building Services Engineers publications, 222 Balham High Road, London SW12 9BS.

Code for Lighting, 2006.

c) Institution of Electrical Engineers publications, The IEE, PO Box 96, Stevenage SG1 2SD.

IEE Code of Practice for In-service Inspection and Testing of Electrical Equipment.

IEE Guidance Notes to BS 7671.

d) Design and Technology Association publications, 16 Wellesbourne House, Walton Road, Wellesbourne, Warwickshire CV35 9JB.

D & T Association (2005), *The Design and Technology Secondary Subject Leader's File*.

D & T Association (2006), *Risk Assessment in Secondary School Design and Technology Teaching Environments*.

D & T Association (2006), *Health and Safety Training Standards in Design and Technology*.

D & T Association (2003), *A Guide for Consultants, Trainers and Teachers for Health and Safety Training in Design and Technology*.

e) Manufacturing Technology Association publications, 62 Bayswater Road, London W2 3PS.

Code of Practice: Safe Working Procedures in Machine Shops.

Code of Practice: Safeguarding Sawing and Cutting-off Machines.

Code of Practice: Safeguarding Grinding and Honing Machines.

Code of Practice: Safeguarding Drilling Machines.

Code of Practice: Safeguarding Turning Machines.

Code of Practice: Safeguarding Milling Machines.

Code of Practice: Safeguarding Machine Centres and Associated Machines.

f) LP Gas Association publications, Pavilion 16, Headlands Business Park, Salisbury Road, Ringwood, Hampshire BH24 3PG.

Code of Practice No. 7, *Storage of Full and Empty LPG Cylinders and Cartridges*, 2004.

g) CLEAPSS Health and Safety publications for design and technology, available from CLEAPSS, The Gardiner Building, Brunel Science Park, Kingston Lane, Uxbridge UB8 3PQ. Tel: 01895 251496.

Model Risk Assessments for Design and Technology in Secondary Schools and Colleges (Generic risk assessments for tools, equipment, machinery and substances used in design and technology).

L 235, Managing Risk Assessment in Design and Technology.

L 254, Health and Safety of D & T Workshop Equipment.

CLEAPSS Laboratory Manual.

CLEAPSS Bulletin (Termly publication with practical advice for all technicians and teachers of science and technology).

h) BEAMA Installation Ltd., Westminster Tower, 3 Albert Embankment, London SE 1 7SL. Tel: 020 7793 3013 email: cac@beama.org.uk

The RCD Handbook. BEAMA Installation Guide to the Selection and Application of Residual Current Devices, 2003.

19.5 British Standards publications

BS 196, *Specification for protected-type non-reversible plugs, socket-outlets, cable-couplers and appliance-couplers with earthing contacts for single phase a.c. circuits up to 250 volts*

BS 411, *Specification for circular saws for woodworking and their attachment*

BS 546, *Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adapters*

BS 638, *Arc welding power sources, equipment and accessories*

BS 1361, *Specification for cartridge fuses for a.c. circuits in domestic and similar premises*

BS 1362, *Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)*

BS 1363-1, *13 A plugs, socket-outlets and adaptors – Part 1: Specification for rewirable and non-rewirable 13 A fused plugs*

BS 1363-2, *13 A plugs, socket-outlets and adaptors – Part 2: Specification for 13 A switched and unswitched socket outlets*

BS 1363-4, *13 A plugs, socket-outlets and adaptors – Part 4: Specification for 13 A fused connector units switched and unswitched*

BS 1710, *Specification for identification of pipelines and services*

BS 2769, *Hand-held electric motor-operated tools*

BS 3641, *Symbols for machine tools*

BS 4278, *Specification for eyebolts for lifting purposes*

BS 4293, *Specification for residual current-operated circuit breakers*

BS 4411, *Specification for woodcutting bandsaw blades*

BS 4676, *Protective clothing – Footwear and gaiters for use in molten metal foundries – Requirements and test methods*

BS 5169, *Specification for fusion welded steel air receivers*

BS 5266, *Emergency lighting*

BS 5482-1, *Code of practice for domestic butane- and propane-gas-burning installations – Part 1: Installations at permanent dwellings, residential park homes and commercial premises with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper*

BS 5499-4, *Graphical symbols and signs – Safety signs, including fire safety signs – Part 4: Code of practice for escape route signing*

BS 5499-5, *Graphical symbols and signs – Safety signs, including fire safety signs – Part 5: Signs with specific safety meanings*

BS 5733, *Specification for general requirements for electrical accessories*

BS 5839, *Fire detection and alarm systems for buildings*

BS 6166-1, *Lifting slings – Part 1: Methods of rating*

BS 7288, *Specification for socket outlets incorporating residual current devices (S.R.C.D.s)*

BS 7671:2001, *Requirements for electrical installations – IEE Wiring Regulations – Sixteenth edition*

BS EN 136, *Respiratory protective devices – Full face masks – Requirements, testing, marking*

BS EN 140, *Respiratory protective devices – Half masks and quarter masks – Requirements, testing, marking*

BS EN 143, *Respiratory protective devices – Particle filters – Requirements, testing, marking*

BS EN 149:2001, *Respiratory protective devices – Filtering half masks to protect against particles – Requirements, testing, marking*

BS EN 166, *Personal eye protection – Specifications*

BS EN 167, *Personal eye protection – Optical test methods*

BS EN 168, *Personal eye protection – Non-optical test methods*

BS EN 175, *Personal protection – Equipment for eye and face protection during welding and allied processes*

BS EN 374, *Protective gloves against chemicals and micro-organisms*

BS EN 388, *Protective gloves against mechanical risks*

BS EN 407, *Protective gloves against thermal risks (heat and/or fire)*

BS EN 420, *Protective gloves – General requirements and test methods*

BS EN 470-1, *Protective clothing for use in welding and allied processes – Part 1: General requirements*

BS EN 529, *Respiratory protective devices – Recommendations for selection, use, care and maintenance – Guidance document*

BS EN 847-1, *Tools for woodworking – Safety requirements – Part 1: Milling tools, circular saw blades*

BS EN 859, *Safety of woodworking machines – Handfed surface planing machines*

BS EN 860, *Safety of woodworking machines – One side thickness planing machines*

BS EN 861, *Safety of woodworking machines – Surface planing and thicknessing machines*

BS EN 1807, *Safety of woodworking machines – Band sawing machines*

BS EN 1870-1, *Safety of woodworking machines – Circular sawing machines – Circular saw benches (with and without sliding table) and dimension saws*

BS EN 1870-2, *Safety of woodworking machines – Circular sawing machines – Horizontal beam panel saws and vertical panel saws*

BS EN 14387, *Respiratory protective devices – Gas filter(s) and combined filter(s) – Requirements, testing, marking*

BS EN 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

BS EN 60079, *Electrical apparatus for explosive gas atmospheres*

BS EN 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

BS EN 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

BS EN 60335, *Specification for safety of household and similar electrical appliances*

BS EN 60529, *Specification for degrees of protection provided by enclosures (IP code)*

BS EN 60669-2-4, *Switches for household and similar fixed electrical installations – Part 2-4: Particular requirements – Isolating switches*

BS EN 60898, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

BS EN 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*

BS EN 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

BS EN 60947-4, *Low-voltage switchgear and controlgear – Part 4: Contactors and motor-starters*

BS EN 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

BS EN 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

BS EN 61558, *Safety of power transformers, power supply units and similar*

BS EN ISO 13850, *Safety of machinery – Emergency stop – Principles for design*

PD 5304, *Guidance on safe use of machinery*

BSI – British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.
Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001.
Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111.
Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002.
Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

389 Chiswick High Road
London
W4 4AL