CLEAPSS

G225 Local Exhaust Ventilation in Design and Technology

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L225 Local Exhaust Ventilation in Design and Technology

1. Introduction

Local exhaust ventilation is used to remove or reduce the level of contamination in workplace atmospheres and thus reduce the risk of ill health in staff, students and visitors. **It is essential that LEV is provided where the risk assessment shows it is required, that it is used, and that it is maintained in good working order. It is also essential that the correct type of LEV is installed so that contaminants are removed from the air**. The purpose of this guide is to help those employers responsible for Design & Technology (D&T) departments in secondary schools and colleges to meet their legal responsibilities to preserve the health of their employees by the use of local exhaust ventilation (LEV) systems. It is not easy to establish just what standards these systems should meet and how their performance can be checked economically.

A subsidiary purpose is, therefore, also to help clarify the daily checks undertaken by the LEV users and the measurements made during the thorough examination and test.

The guidance presented is based on published advice from the Health and Safety Executive (HSE), visits to school and college workshops (where measurements were made with a dust monitor and photographs taken using a dust lamp) and discussions with experienced health and safety advisers. The visits showed that:

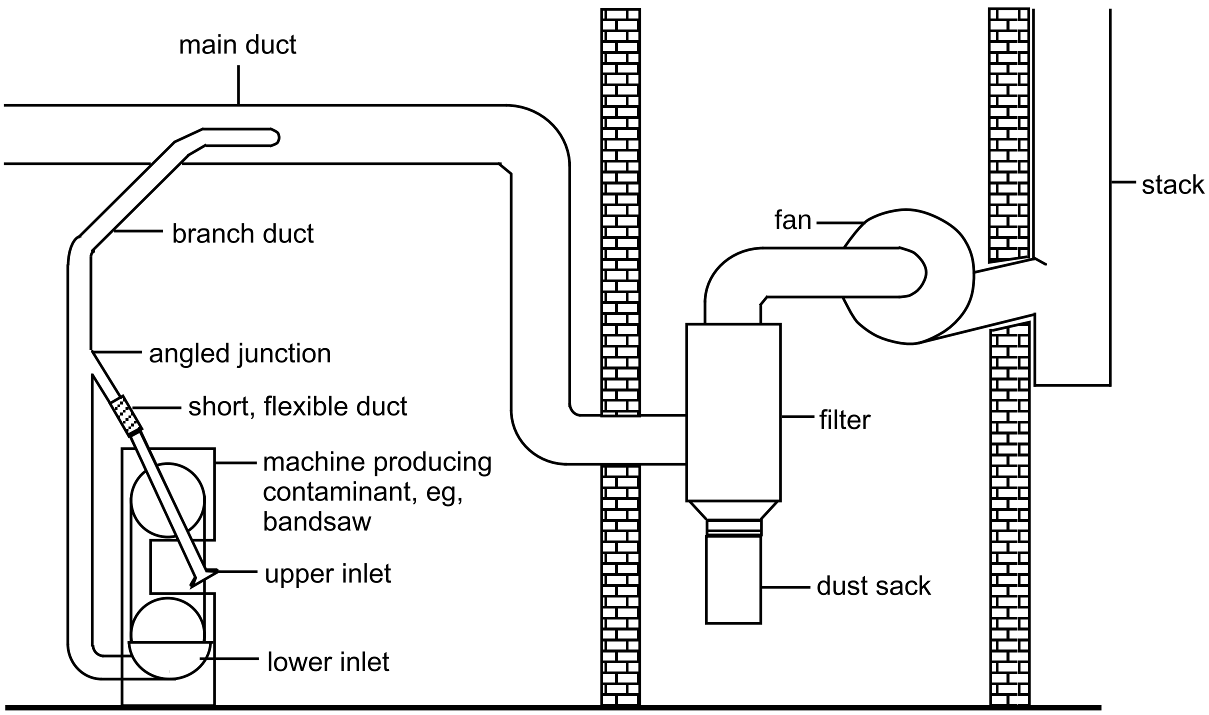
- some LEV systems are not well-designed;
- some LEV systems are not supplied with performance data on installation. This is necessary so that subsequent testing can be compared with the performance on installation;
- tests are not being carried out within the statutory 14 month period (see section 2.2);
- there is considerable uncertainty over which tests are really adequate when contractors use different performance criteria;
- there is little recognition of the significance of the Workplace Exposure Limits (WEL) for wood dust (see section 3.2) and the consequent requirement to keep levels as low as reasonably practicable;
- inadequate maintenance often prevents systems from achieving the efficiency of which they are capable.

1.1 What is local exhaust ventilation?

General ventilation of the workplace dilutes any contamination of the air but does not give a control at the source. Local exhaust ventilation is designed to intercept a contaminant as close to the source as possible and carry it away through a duct, often to a filter unit, before passing the air to the atmosphere outside or possibly back into the workplace[1]. A typical LEV system comprises the following components in order. (See list and diagram overleaf.)

1 See *Controlling airborne contaminants at work*, HSG 258, HSE Books, 2008, ISBN 978 0 7176 6298 2.

1. A hood, enclosure or other inlet device that will collect the contaminant at its source.
2. A duct through which air flows to carry the contaminant away from the source.
3. Where necessary, a filter, bag or other air-cleaning device to remove sufficient of the contaminant to allow the air to be passed to the outside or returned to the workplace.
4. An air mover, usually a fan, to produce a difference in air pressure so that the air flows as required. The inlet device, duct and filter then contain air at a pressure below atmospheric.
5. Further ductwork to carry the cleaned air to the outside or back into the workplace. This ductwork contains air at a pressure above atmospheric.



It should be noted that there are different types of capture hoods used in LEV systems.

Receptor or receiving hoods where heat or fumes rise into the hood assisted by an extraction fan. In D&T departments the most common example of this type of hood is extraction from cookers and heat treatment areas in workshops.

Capture hoods are used where the source and the contaminate cloud are outside of the hood. The capture type hood has to generate sufficient air flow at and around the source to draw in the contaminant. Capture hoods include the extraction from the tip of a soldering iron and those used on most woodworking machines and for welding fumes.

The third type of capture hood is the enclosing hood. In schools the most common example of this type of hood is a fume cupboard used in science, but partially enclosing hoods are found in D&T including paint spray boots used in graphics and in workshops.

1.2 What contaminants occur in educational D&T workplaces?

The Health and Safety Executive refers to a whole range of contaminants that may occur in D&T workplaces but, in education, the rate of production or the duration of the activity may be too low or too short to require LEV. This is a matter for risk assessment and each case is discussed in the CLEAPSS publication *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*[2]. Table 1 summarises the situation and gives specific references to the *Model Risk Assessments (MRAs)*.

Table 1: Air contaminants and their control

Contaminant	Size range / μm[§]	Examples (references to CLEAPSS MRAs)	LEV required in education?	Air filter
Particles	>100	Grinding dust (metal) (1.034) Wood chips (1.082)	Possibly Probably	Not needed
Dust	0.1 - 100	Wood dust (1.071) Textile dust (2.021) Flour (3.029)	Yes Unlikely Unlikely	Fabric or paper
Mist	0.01 - 10	Spray from etching tanks (1.014 & 1.015)	Not if a lid is used	Not needed
Smoke	0.01 - 1.0	Casting in oil-bonded sand (1.020) Tests on burning textiles (2.010)	Yes No	Not needed
Fume	0.001 - 1.0	Solder fume (1.025) Welding fume (1.028, 1.030) Casting fume (1.020)	Possibly Yes Yes	Combination
Vapour	0.005	Solvent vapours (1.068, 1.069)	Possibly	Activated carbon
Gas	0.0005	Forge gases (1.022) Vehicle exhaust (1.050)	Yes Yes	Vent to atmosphere

Note Fumes from forging are only usually a problem if coke-fired forges are used.

1.3 Capture velocity

The capture velocity is the air velocity necessary to draw the contaminant into the inlet of the LEV system. The HSE recommends[3] different capture velocities for different situations and different contaminants. These range from 0.25 m s^{-1} for the solvent vapours released by paint drying, up to 10 m s^{-1} for dust released from fast machines with small collection inlets. However, the capture velocity required also depends greatly on the design of the hood forming the inlet aperture.

1.4 Duct velocity

The duct velocity required to keep the contaminant flowing in the duct also depends on the nature of the contaminant. Dusts and particles drop out of the flow unless it is sufficiently fast. Gases, vapours, smoke and fumes require only low velocities while dusts require at least 15 m s^{-1}, with heavy particles requiring at least 25 m s^{-1}. For a given capture velocity and inlet size, the smaller the duct diameter the greater the duct velocity but the resistance to the flow is also increased. The small duct diameters (75 to 150 mm) usually used in education require relatively powerful fans that may increase the noise generated.

Flexible ducting is frequently used in LEV systems in educational establishments. However, it has a relatively high flow resistance[3] because of its corrugations, so long lengths and bends should be avoided.

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2 For details, see the entry under model risk assessments in Appendix 1.

§ 1 μm is one millionth of a metre.

3 See *Controlling Airborne Contaminates at Work* HSG 258, HSE Books, 2008, ISBN 978 0 7176 6298 2.

2. Design of Local Exhaust Ventilation systems

Several different kinds of local exhaust ventilation system can be used in education, each with advantages and disadvantages. Most establishments will end up using more than one system. The types are compared in Table 2 overleaf. Table 2A covers dust-collection systems and Table 2B covers fume extraction.

2.1 Guidelines on LEV design and layout for dust extraction

It is important that those involved in making decisions about what type of LEV system to install consider the needs of the department, the way in which the system is used, and the impact that usage will have on teaching and use of machines. The main problems are to do with collection of dust and wood shavings from woodworking machines. The Health and Safety Executive have published a very detailed guide to the design and operation of LEV systems and some important points from this document are given below.

2.2 Guidance from the HSE

The HSE has issued several helpful guidance publications. *Controlling Airborne Contaminates at Work* is the most relevant, and is discussed below.

Controlling Airborne Contaminates at Work HSG 258

This book is intended to provide guidance to suppliers of LEV equipment, employers and to trade union and employee safety representatives. It covers the roles and responsibilities of those involved in the design, supply, installation, and commissioning of LEV equipment, and the responsibilities of the employer and the employee who used LEV equipment. There are helpful sections on the maintenance and repair of LEV equipment and in the statutory annual examination and test. The publication is primarily set in an industrial context and it therefore its application to schools is limited. It does, however, represent best practice. A school that is considering the purchase of new LEV equipment should check that the supplier is aware of the requirements in the document and should be able to confirm that any system to be supplied meets those requirements. This applies to any LEV system, including small portable units as well as large systems with fixed ducting. Appendix 2 gives a summary of the requirements.

Table 2: Different types of LEV: 2A: Dust-collection systems

Type	Characteristics	Noise	Advantages	Disadvantages
Fixed installations for whole area serving several machines	a. Inlets at each machine or source, possibly with dampers that can be closed when the inlet is not in use. b. Fixed ducting. c. A fixed filter or dust- collection system. d. A fan. e. An outlet that might return air to the workplace or vent it to the outside.	Depends on design. [Sound levels greater than 80 dB(A) make verbal communication difficult. Where the noise exceeds 80 dB(A) ear defenders are normally required.]	Only one dust-collection point to attend to and one filter to clean or replace. The noise is low if the fan is outside the workplace and the duct does not carry sound.	Often large plant, e.g. an extra building is needed to contain the fan and filter units. High noise levels if the fan etc is in the workplace and/or if the ducting transmits sound. This may lead to ambient noise problems in rooms where quiet is needed. Extra electrical controls may be required to ensure that the system is operating when any one machine is in use. Users will need training to operate dampers. If the extraction unit fails none of the machines connected to the system can be used.
Independent installations at each machine	a. Fan unit is close to the machine producing the dust. b. Fan and machine are often electrically linked, so that the fan is powered whenever the machine is running. c. For dust control, the filter / dust-collection system is normally mounted in the same unit as the fan.	Can be a problem unless each fan unit is very quiet.	Units are often compact, being designed to fit under the bench or into the pedestal supporting the machine. Automatic starting of the dust control is easy. Failure of one unit does not affect use of any other machine.	Many dust-collection bags and/or filters to attend to. Many fans can generate much noise. The relatively small filter area and size of unit can result in the filter becoming clogged and hence a lack of efficiency. These units are unlikely to cope with large volumes of waste such as those produced by wood planing machines.
Portable systems	A mobile duct, filter, dust sack and fan unit, which can be moved between machines. The inlet may be general purpose or part of each machine.	A serious problem unless each fan unit is very quiet.	An economical solution for a workshop containing several machines with intermittent use.	General-purpose units are not always efficient and may not adequately control contaminates. Difficult to make system and machine electrically interlocked. It is then debatable whether or not the system fulfils legal requirements. There is a high risk that LEV may not be used because of the fuss of connecting up.
Extraction from portable power tools	A very flexible duct connected to a stand-alone dust collector or a small dust bag connected to the tool.	Portable power tools are often noisy anyway and the extra noise associated with the dust-collection system may be trivial.	Protection for the user. This type of system will also protect others nearby.	The dust-collection system may make the tool difficult to control. If a small dust bag is fitted, it can be filled after only a few minutes work and must be changed or emptied frequently.

Table 2: Different types of LEV: 2B: Fume-extraction systems

Type	Characteristics	Noise	Advantages	Disadvantages
Fume extraction from hot metal areas	Hearths, forges, welding benches and crucible furnaces fitted with either: a. individual fume extraction, or b. a combined system with a damper fitted above each inlet to control the air flow into the duct. c. flexible ducting that can positioned where needed.	A combined system with a single fan is less noisy than separate fans for each unit when more than one is in use.	LEV is run only when it is needed and may be interlocked with the system used to heat the metals. The flexible arm/ ducting can be effective provided that it is positioned correctly in relation to the source of fumes.	The dampers should be set on installation to balance the flows, so that all units have adequate fume extraction, and should not then be moved. In practice, the crucible furnace may produce such a lot of fumes (e.g. during degassing) that the system will only collect them if all other dampers are closed manually. It is then unlikely that the users will return the dampers to their previous settings.
Solder fume (where rosin-cored flux is not replaced by rosin-free type)	Systems either use inlets on each soldering iron or air currents that are drawn across the work away from the user. In both cases, the air is filtered and returned to the workplace.	Noise is not usually a problem with these small systems.	The systems remove the fumes produced by rosin-cored flux.	The filters need regular testing for saturation and changing when necessary. The inlet tubes used for tip extraction get blocked and require frequent maintenance.
Solvent vapour control	Spray booths for painting small components are available commercially or improvised using sheets of hardboard or even cardboard, and sit on a bench. An exhaust fan takes the air from the booth straight through a wall or window to the outside. Alternatively, a filter is provided to catch the paint aerosol and/or solvent before the air is returned to the workplace.	Noise is not usually a problem with these small systems.	Venting to the atmosphere avoids the need for filters.	Where the system exhausts to the outside air, it is necessary to ensure that the outlet is well away from any area where vapour could be inhaled by anyone. If filters are used, they must be tested regularly for saturation and changed when necessary. The air flow rate may not be sufficient to control the contaminant.
Fumes from laser cutters	Usually a filter system housed in a cabinet alongside the machine is needed. In some systems there may also be a flue that will take fumes to outside the building.	Noise is not usually a problem with these systems.	Venting to the atmosphere avoids the need for filters.	Filters need to be changed regularly according to the manufacturer's instructions. In some systems residual fumes can cause discomfort. The smell from cutting can be unpleasant even where LEV is used.
Extraction from CNC machines such as milling machines and routers	Some of these machines are totally enclosed within a cabinet fitted with electrical interlocks. In these cases it may be better to remove dust after the machine has finished its cycle rather than trying to extract it.	Noise is not usually a problem with these systems.		The volume of dust produced can be an issue and will certainly be significant on large machines that may not be fully enclosed.

2.3 Design requirements for dust extraction from woodworking machines

For collecting wood dust LEV systems will normally be one of three types: a multi-branched ducted system serving all rooms and leading to a large collection unit, which may be outside the building; a discrete ducted system for each room; individual extraction units for each machine. The advantages and disadvantages of these are given in table 2A but some important design criteria are outlined below.

The most important function of an LEV system is that it should control the contaminant. The flow rate needed to collect and remove the contaminant, the type and design of hood, the capture velocity and the filter media, if any, are all important. Teachers and technicians are not expected to have this specialist knowledge but those involved in the specification for LEV systems should ensure that a suitably qualified person who does is involved in the design. Because of this, purchasing off-the-shelf units and having it installed by a technician is not recommended.

There is an important design consideration in the extraction of dust from circular saws, sometimes called table saws. Some circular saws have a cowling fitted round the lower part of the saw blade below the saw table. These cowlings are fitted with an extraction point that is usually connected via a flexible pipe to the main extraction system. CLEAPSS staff have found that it is very easy for the extraction point from such cowlings to become blocked by slivers of wood that then allow the dust to clog the pipe. We have several examples where the extraction point is totally blocked to the extent that no dust is being collected from the machine. It is essential that the collection point on any machine is checked to see that it is of sufficient size. 65mm diameter should be considered the minimum size for effective use.

A large system with ducting to each machine can be noisy and, in the vicinity of the collection unit, the noise can exceed 80dB. Where the noise is above this level ear protection would normally be required. In addition, the ducting will often transmit ambient noise throughout the building and this can disrupt teaching, especially when the teacher needs to talk to the whole class. In a large system serving several rooms and a resistant materials preparation room, it is likely that at least one machine that requires LEV will be in use at any one time. This means the unit may well be in operation for most of the day producing a constant background noise. If the collection unit is located in the preparation area this constant noise may become intolerable for a technician spending much of their working day in the room.

Some collection units are designed so that they can be placed outside the building. This can be very effective, but the unit will need to be protected from potential vandalism damage by enclosing it in a suitable cage, and, where necessary, from damage from passing traffic on internal roadways or in car park areas. Being outside will reduce the noise inside the building but may introduce additional costs. Collection units may be installed in a plant room or storeroom within the building but, again, additional costs may be involved. Because of the risk of fire, units should not be installed in boiler rooms, or rooms containing the main electrical switch-gear. The other significant issue to consider is that if the system fails, none of the machines connected to it can be used. This could place most of the machines in a department out of use for some time. An alternative to one single large system is to have discrete ducted systems for each room. Although the issue of noise still has to be considered, having several systems means that individual teachers can control the use in their own room, and if one system fails others should still be useable.

Individual LEV units by each machine can overcome some of the problems outlined above. The main disadvantage is that additional space is required to accommodate the extraction units although some smaller units can be placed under benching. Collection units for circular saws can often be placed below the take-off table of the machine. Noise may be a problem with individual units.

Schools often find it most useful to have a large ducted system for the main resistant materials preparation area and smaller systems, or individual units in other teaching rooms.

Portable power tools used on wood, and even sanding by hand, can produce considerable amounts of dust. As is noted in table 2, extraction from portable power tools is not easy. One solution is to use a down-draft table, sometimes called an air table. These are, in effect, a perforated work top on a stand that has a built-in extraction system, although some larger types can be connected to a fixed LEV system. Provided that they control the amount of dust produced these can be effective, and are suitable for use with portable power tools and for hand sanding. These tables are not common in schools, probably because the space needed is equal to that of a standard workbench. Down-draft tables should be subject to an annual COSHH check.

2.4 Criteria for an LEV specification

HSG 258 lists the following criteria that should be included in the quotation from a supplier for any new LEV system.

The potential supplier should:

- Provide a technical drawing of the system.
- State the type of hood for each source of contaminant, its location or position in the system, the face velocity at the hood and the static pressure.
- Include information on any constraints on the way in which the system is used, e.g. on the number of extraction points that may be used at any one time.
- Describe the ducts - material used, dimensions, transport velocity where appropriate and volume flow rates.
- Include details of how the air flow in different branches of the LEV will be balanced.
- Describe any air cleaner fitted to the system, e.g. volume flow rate and static pressure ranges at inlet, outlet and across the cleaner.
- Describe the fan or other air mover e.g. volume flow rate and static pressure at inlet and direction of rotation of fan.
- For systems that return air to the workplace, provide information on air cleaner efficiency and sensors that monitor cleanliness of the air.
- Describe the indicators and alarms that are to be provided to show that the system is working correctly and which will give an indication of a failure of the system.
- Describe the commissioning tests to be carried out.
- Provide adequate training in using, checking and maintaining the system.
- Provide a user manual and a logbook.

When schools and colleges are buying a new LEV system, or when employers are providing a new system, care should be taken that all these criteria are applied to the specification. Similarly, if new buildings are being provided by the employer or under a Private Finance Initiative scheme, heads of D&T should ensure that any LEV system conforms to these criteria. Any school that is considering the purchase of off-the-shelf units should also ensure that the system meets these criteria otherwise there is a risk that contaminants will not be effectively controlled and the health of employees will be put at risk.

2.5 Electrical control for large LEV systems

The electrical controls for LEV systems are an important part of the design of the system. The best arrangement for any system is for the collection unit to start when any machine is switched on. This will ensure that the LEV is always used, and for both large systems and individual units some sort of remote control or linked start-up is often provided. For small LEV systems an acceptable alternative is for the LEV control switch to be located alongside the machine or on the unit itself, if this is close by. This arrangement is often employed on LEV that extracts from a single machine.

Where a system is designed to serve all the machines in one room only one control switch may be provided. This is not appropriate, since there is a risk that users will fail to turn on the extraction unit. A large system that will extract from all the machines across several rooms may have one control in each room, but this is also not ideal. A single start control that is located alongside the extraction unit itself is not acceptable since this may be some distance from the machines that it serves especially when the unit is in a plant room. In general, each machine should be linked to the LEV start-up system. Where there is any sort of remote start-up control, a suitable isolating switch should be installed alongside the extraction unit to allow it to be isolated during maintenance or emptying.

2.6 Significance of multiple collection points

Systems are often designed to allow more than one collection inlet. If the air-flow is appropriately balanced, all collection points can be made to work adequately and simultaneously. However, in some systems, perhaps because a small, less noisy fan has been fitted, not all of the collection points can be used simultaneously. A system of dampers or blast gates is then required to close off those parts which are not in use in order to achieve an adequate air flow at the points that are being used.

Unfortunately, operators may fail to close unused inlets or fail to open those that are needed. Frequent instruction and written reminders (perhaps adjacent to each inlet) will be required to overcome this problem, particularly in schools with a high staff turnover. There is an additional problem in school workshops where it may be unreasonable to expect pupils to operate damper controls because they will not understand how to set them effectively.

HSE recommends that air-flow indicators are provided to allow the operator of any machine to ensure that the flow of air in a system is sufficient to control the dust or fumes. One way of doing this is to install a manometer near to each collection point. Although this is essential in an industrial context, and may be useful in a preparation room, such an arrangement may not be appropriate in a workshop used by pupils since they may lack the understanding to control the blast gate settings. However, it is important that LEV systems in schools are checked regularly by a teacher or technician to ensure that they are functioning correctly and some method of measuring or checking air flow should be available. Methods of doing this are discussed in section 4.2. It is important that, when an LEV system is tested, the person doing the testing understands how the ventilation system is used in practice, if tests of its operation are to be realistic. If tests are carried out when the regular staff operators are not present, it is essential that the tester is given written information on the mode of use of the ventilation system.

2.7 Flexible ducting

In order to reduce costs, flexible ducting is used extensively in educational LEV systems. Unfortunately, because of its corrugations, it presents a greater resistance to the flow of air than smooth pipes. To achieve a given performance, a more powerful fan is required to make the air flow through long lengths of flexible ducting. Flexible ducting is also more easily damaged than rigid ducting. A well-designed system therefore uses only short lengths of flexible ducting which are as straight as possible, with bends being formed out of rigid pipes.

2.8 Individual extraction units

Individual dust extraction units may be used in some situations where the cost of a ducted system cannot be justified. These vary in quality and may range from a simple vacuum cleaner to a high quality unit enclosed within a steel casing. Some of these units can be used as a stand for machines such as sanding machines that would otherwise need to be fixed to a bench.

An essential feature of any LEV system is that is should correctly control the contaminant. It should be recognised that a standard off-the-shelf unit, such as are available from a number of manufacturers, may not provide adequate control. Schools contemplating buying such units must ensure that it/they will do the job. Guidance in HSG 258 states that it is the responsibility of the supplier to ensure that they system supplied will provide adequate control and to provide a commissioning certificate to show the performance on installation. By their nature off-the-shelf units will not be supplied with commissioning reports. It will therefore be necessary to arrange for a commissioning test and report.

An important feature of individual units is the size and type of the container that stores the dust. Most free-standing, individual units are unlikely to have a container of sufficient size to cope with the volume of chips and dust produced by a wood-planing machine, for example, unless only very small quantities are produced. They may however be sufficient for a small band saw, bench mounted jigsaw or a sanding machine.

Some dust extraction units are contained within rectangular steel casings and these will usually collect the dust in a tray or drawer that needs to be emptied by hand. The person emptying the tray should wear a face mask (see section 7.1). Some units will collect dust and chips in a clear plastic bag. These may be hung below the fan on a floor-mounted unit, which may also be portable, or the unit may be fixed to the wall with the bag hanging below. Plastic bags are vulnerable to damage, either accidental or deliberate and if punctured must be replaced. The bags fitted to wall-mounted units may be heavy when full and, because of the position of the unit on the wall, may be difficult to lift down. Some units have a large filter bag which is placed above the fan and which inflates when the unit is started. Whilst such designs will normally be adequate, blocking the filter can reduce the efficiency of the unit. The filter will also need space to expand so this type of unit cannot be placed under a bench. A further type of free-standing unit is contained within a circular drum with the dust collected in the bottom. Again, a face mask should be used when emptying.

2.9 Extraction of solvent fumes

The CLEAPSS *Model Risk Assessments for Design and Technology*[4] discuss various processes involving solvent fumes. Most school operations are on a sufficiently small scale to avoid the need for fume extraction but spray painting in some colleges will require proper booths with extraction, particularly where isocyanate paints are used.

2.10 Extraction of solder fume

The fume produced by rosin (colophony) -based flux materials is hazardous. Rosin-based fluxes are used for electrical work (with hand-held soldering irons) and plumbing or other pipe-fitting work[5]. The HSE has advised educational establishments to avoid the use of rosin-based fluxes by using rosin-free types. It is hoped that this will avoid the need for LEV on soldering benches where there is good general ventilation but the advice may change as experience grows with alternative fluxes. Extraction may be needed if a large amount of soldering is done, as may be the case in systems and control courses at examination level and where soldering is done in rooms with fairly low ceilings. It may also be needed by teachers and technicians using a soldering iron for long periods of time, perhaps in a small room. Pupils with respiratory problems may also need to use fume extraction.

2.11 Dust masks: an alternative to ventilation?

It is neither acceptable nor practicable for everyone in an educational workshop to wear a dust mask capable of containing toxic dusts; see section 7.1. ‘Nuisance’ dust masks[6], as sold by some d-i-y shops, do not give significant protection.

A toxic dust mask may, however, be needed by the person who is emptying dust containers or carrying out other maintenance (when the collection system is necessarily switched off); see section 7.1.

2.12 Minimising the explosion risk with mixed particulates

Wood or plastics dust suspended in the air can form an explosive mixture that may be ignited by a spark. It is for this reason that ferrous metals should not be ground, sawn or sanded on a machine which has just been used to abrade wood or plastic. There are instances of dust in ducting being ignited as a result of ferrous metals being cut or sanded on machines normally used for shaping wood. It has also been know for some workers to sharpen wood-working tools such as chisels and plane blades on sanding machines which will cause the same problem. In any case this is poor practice and should not be done. The same LEV system should not be used to handle both flammable dusts and metal particles. If plastics are cut the filters should be cleaned, and dust-collection bags should be changed, between the different uses of the machine. It is simpler and safer to have separate machines with their own extraction systems or separate workshops. There is a theoretical risk of igniting wood dusts if plastics are cut without first emptying the system of wood dust but extensive research by CLEAPSS has yet to find any examples of where this has happened.

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4 *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*, e.g. see Assessments 1.007 and 1.085.

5 *Solder Fume and You*, 2002, HSE Books, INDG 248 (rev). Free publication.

6 Those with just a layer of gauze held in place with a thin aluminium support are considered to give no protection against toxic wood dust. Better d-i-y shops sell dust masks meeting EU standards that will offer suitable protection; see section 7.1 for details.

3. Legal requirements

Health and safety in the UK is controlled by the *Health and Safety at Work etc Act*, 1974 (HSW Act) and regulations made under it. These are discussed below.

3.1 Health and Safety at Work etc Act, 1974

Section 2 of the Act places on employers[7] the general duty to ensure the health, safety and welfare of all their employees at work so far as is reasonably practicable. Section 3 of the Act extends this duty to non-employees (i.e. visitors, students and pupils). School and college staff may be so concerned about these 'others' that the duty to employees takes second place. Statistics show that staff of all kinds have more accidents than expected and a number of health problems. There are, for example, instances of teachers and technicians suffering permanent damage to their health as a result of failure to control wood dust. However, for students and pupils, health problems are virtually unknown and serious accidents are rare, as a proportion of the number of individuals present. Generally, the low rate of health problems for pupils is ascribed to the fact that they are exposed to dusts and fumes for only a few hours each week while staff are often in the workshops nearly all day.

3.2 COSHH Regulations

The *Control of Substances Hazardous to Health Regulations* are intended to protect the health of persons at work from the substances to which they might be exposed. The Regulations have been revised several times since they were introduced in 1988; the current edition is dated 2002.

The regulations cover substances on the skin and substances taken into the body by the respiratory system as well as by swallowing. Substances include carcinogens and biological agents as well as chemicals that act to the detriment of the health of the person exposed.

Workplace Exposure Limits

Information on hazards from substances is provided by a system of Workplace Exposure Limits (WELs) which refer to concentrations of each hazardous substance in the air.

These limits are subjected to 'time weighting', i.e. the actual concentration is the average value over either 8 hours or 15 minutes. Although this means that, for many activities, these limits are unlikely to be exceeded in an educational workshop, there are situations where a risk assessment shows that a high level of contaminant could be reached. (See the CLEAPSS *Model Risk Assessments for Design and Technology* for details.) Even if the limit is not likely to be exceeded, the employer is still required to keep the levels **as low as reasonably practicable**. It is therefore difficult for an employer to argue that, in any secondary school workshop, the level of dust is so low that no precautions are necessary.

In school and college D&T departments, local exhaust ventilation is likely to be necessary to control wood dust, which has a WEL of 5 mg m^{-3}, and fumes from hot processes. Precautions may also be required for other activities such soldering which may produce fumes, and, possibly in colleges, handling large amounts of flour. Flour has a WEL of 10 mg m^{-3} over an 8 hour period and 30 mg m^{-3} over a 15 minute reference period. Since flour is an asthmagen, exposure must be reduced well below the WEL and be kept as low as is reasonably practicable. Solvent fumes from paint spraying are

7 For community and voluntary-controlled schools, the employer is the LEA. For foundation schools, voluntary-aided schools, academies, city technology colleges and independent schools, and for sixth-form and further education colleges, the employer is the governing body (or possibly a trust or the proprietor).

The health & safety responsibilities of employers are spelled out in *Health & Safety: Responsibilities and Powers*, DfES/0803/2001; available on www.teachernet.gov.uk/wholeschool/healthandsafety/responsibilities/.

unlikely to be a problem in schools where the scale is usually small). In colleges a proper paint-spraying booth with extraction may be needed for teaching Art and Design, Design and Technology and bodywork repairing in Motor Vehicle workshops. There have been instances where fumes from the melting of paraffin wax in electrically heated pots in textiles rooms has caused headaches. The WEL for paraffin wax is 2 mg m^{-3} over an 8 hour period and 6 mg m^{-3} over a 15 minute reference period. These limits may well be exceeded if more than one pot is in use. Where paraffin wax fumes are a problem, opening a window will normally provide sufficient ventilation.

Although the *COSHH Regulations* apply to non-employees only so far as is reasonably practicable, the general duty on employers under the *HSW Act* Section 3 means that it is wise to apply the same limits for ‘others’ as for staff.

Risk Assessment

The Regulations require the employer to make a ‘suitable and sufficient assessment’ of the risks created by the work activity to the health of the employees. In education, this assessment process is often assisted by consulting model risk assessments (e.g. *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*). However the process is done, the outcome should be a series of control measures[8] that are to be adopted to ensure that relevant limits are met. In some cases, the general ventilation in the workplace should be sufficient to keep down the concentration of hazardous substances but, in other cases, general ventilation will need to be supplemented by LEV.

Maintenance

COSHH Regulation 9 requires that every employer who provides a control measure shall ensure that it is maintained in an efficient state, in efficient working order, in good repair and in a clean condition. Even if the task of maintaining LEV is delegated to individual schools, it is the employer who has the duty to make arrangements for monitoring that it is done.

In practice, this means that someone must make a simple check that the LEV is working every time the system is used, e.g. by holding a strip of paper near the inlet to see if it is deflected by the air-flow. It would be advisable for further checks to be made once each week, for example, by removing a side panel from a circular saw to confirm that off-cuts falling inside have not restricted the inlet to the dust-collection system and checking to see that flexible hoses have not become blocked. Collection points from circular saws in particular can easily become blocked, especially if the collecting duct is in the form of a cowling around the blade, and this should be checked on a weekly basis. Clearly, this must be done by people who are qualified to remove access panels and replace them correctly under conditions that do not put their health and safety at risk. For example, it is essential to ensure that a machine is locked off before any such checking procedure is carried out.

HSG 258 recommends that air-flow indicators are fitted at each collection point so that users can check that the system is working. Currently (September 2009) this is only a recommendation although some companies that design and install LEV may try to insist that it is a legal requirement. The HSE recommends that the user should ensure that the extraction system is working and something needs to be in place that will allow this to be done. Checks could be done using an anemometer, if available (in the duct),a manometer, a smoke pellet or smoke pencil. A useful quick visual check is to see if dust is collecting on top of a band saw for example, or in the base of a band saw or circular saw, or if dust collects on horizontal surfaces around rooms where machines are located. Dust in these places

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8 If the CLEAPSS models are not appropriate, the assessor should bear in mind the hierarchy for controlling risks described in *Five Steps to Risk Assessment*, HSE, available from www.hse.gov.uk.

indicates that the system is probably not working effectively. The HSE web site www.hse.gov.uk/lev/faqs.htm provides some very helpful information on what is and is not required in LEV systems.

Testing intervals

When the risk assessment shows that LEV is required for adequate health and safety, *COSHH Regulation 9* requires, in general, that it is examined and tested at least once every 14 months (in practice, an annual test). This applies to all methods of collecting wood dust, including simple systems where a vacuum cleaner may be used, and fume extraction from heat treatment equipment. In the case of a system used to control fumes from non-ferrous metal casting, the interval is reduced to 6 months. However, in many educational establishments, non-ferrous metal casting is done during a period of a few weeks and not repeated until the following year. In such cases, an annual test of the LEV, allowing sufficient time before use to correct any defects, would provide testing at intervals of less than 6 months *of use,* and would meet the spirit of the regulation.

It is the employer's responsibility to ensure that these tests take place at the required intervals and according to an agreed procedure. However, arrangements for the tests to be carried out could be delegated to the school or college. Any such delegation should be in writing and explicit, and the employer must monitor that delegated tasks are actually performed. When such tests are carried out, a copy of the test report should be provided for the school, and a copy of this should be held by any department that has LEV equipment in use. See also Section 6 for discussion of thorough testing to meet the 14 month requirement.

It is a general principle[9] that personal protective equipment should only be used as a last resort when other control measures such as LEV are impracticable. So, a dust mask may be required while emptying dust containers or carrying out maintenance checks but should *not* be needed during machine operations, except in special circumstances; see section 7.1 for further information on dust masks.

3.3 Other regulations

The *Control of Lead at Work Regulations* apply to certain processes in school and college workshops, such as casting lead and its alloys. Soldering with small irons and temperature-controlled systems does not give rise to significant levels of lead vapour (which would be covered by these Regulations) but does produce fumes from fluxes which is a matter for the *COSHH Regulations*[10] (see section 3.2). The use of lead-free solders will reduce the risk of harm from lead but may increase the level of fumes from the flux used. It is recommended that casting lead or its alloys is avoided in schools and colleges and that 'lead-free pewter'[11] is used instead. Colleges teaching building techniques may need to handle lead flashing which can give rise to significant lead contamination of the skin. Reference should be made to the Approved Code of Practice[12].

9 See the *Management of Health and Safety at Work Regulations* or the *COSHH Regulations*.

10 *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*; see Assessment 1.025.

11 *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges*, see Assessments 1.019 and 1.020.

12 *Control of Lead at Work Regulations* 2002, *Approved Code of Practice and Guidance*, HSE Books, 3rd edition 2002, ISBN 0717625656.

4. Examination methods

In this section we consider those examination methods which are theoretically possible. Section 6 gives details of the tests that should be used to comply with the requirement to examine the functioning of LEV systems every 14 months or less.

4.1 Measurements of air quality

The purpose of local exhaust ventilation is to ensure that air that is inhaled will not damage a person's health. The contaminant or range of contaminants that might be present in the air must be known, if appropriate tests are to be carried out.

Quantitative and semi-quantitative tests

For some substances, there are instruments which draw in samples of the inhaled air, automatically measure the concentration of the particular substance and show the result as figures on some kind of display. Such figures may look very impressive but the user must be aware of the limitations of the instrument; some results could be inaccurate because of the presence of another contaminant, others could need a calibration correction, etc. These tests are particularly useful for measuring the concentration of fine dusts that are invisible under normal lighting. Instruments that are suitable are listed in the accompanying document PS62[13].

In other tests, samples of the air are drawn through a tube containing chemicals and an indicator changes colour according to the concentration of the substance being tested for. These systems are often referred to as 'semi-quantitative' because the precise extent of the colour change in the tube may be difficult to determine, the volume of air drawn in may be uncertain, etc. Nevertheless, these uncertainties are often no greater than those introduced by the choice of sampling position or test conditions. Such measurements may be as accurate as those from a much more sophisticated instrument. They are useful, for example, for monitoring levels of solvent vapours. Suitable detection kits are available from Anachem Ltd (for Gastec products) or Draeger Ltd (see PS62).

Qualitative tests for dust

In the case of dust or any other particulate contaminant, the Tyndall Dust Lamp can provide a qualitative indication of whether or not a problem exists[14]. When a strong beam of light is passed through a cloud of dust particles, the light is scattered by the particles, making them visible. The effect is particularly strong for the fine particles that make up 'respirable dust', which is responsible for certain health conditions.

The referenced document discusses in some detail the principles of using a beam of light to reveal the presence of a cloud of particles. It discusses lamps, video and still photography and different photographic films. There is no doubt that this technique, properly used, can graphically reveal the extent of a problem but it does not give any quantitative results.

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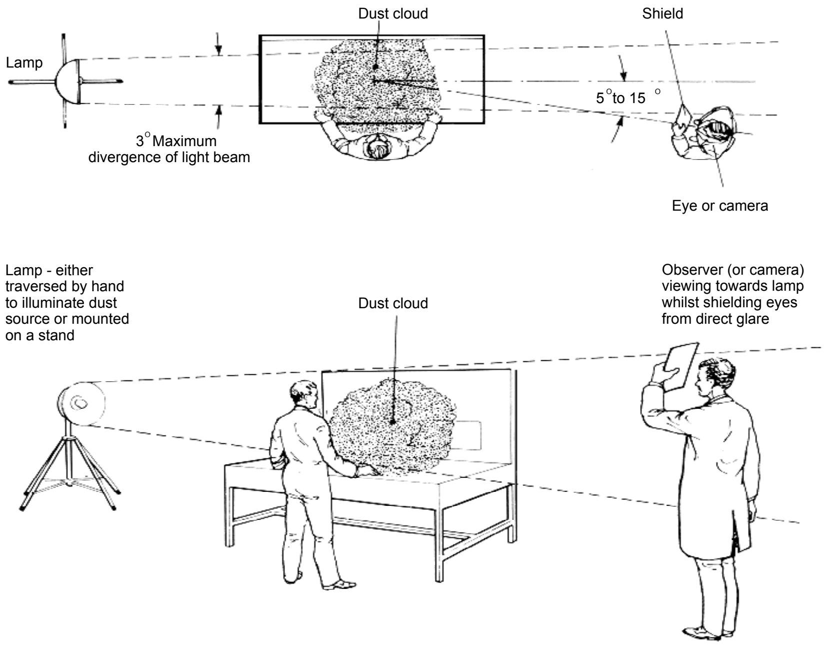
13 For details of the equipment and addresses of suppliers, refer to PS62, *LEV in Design & Technology: Suppliers, Testers and Monitoring Equipment*. This will be regularly updated, so readers should check for the latest issue.

14 The *Dust Lamp: a simple tool for observing the presence of airborne particles*, MDHS82, 1997, HSE Books, ISBN 0717613623, gives full details of this technique. Available via www.hse.gov.uk/lev.



The lamp does not have to be a special one if it produces a confined beam of strong light. A stage spotlight or slide projector may be suitable. If photography is being used to record the result, the beam should be 'photographically white' but, for visual observation, the colour is not important. The required arrangement is illustrated[15] above.

In use, the lamp is usually set up to produce a beam in front of the face of the user of a machine or process. The observer stands facing the lamp but with a screen to protect the eyes from the direct beam. It is often useful to reduce other lighting in the area and then the dust cloud, if there is one, will become visible. The presence of a visible cloud means that the dust-control system is not adequate to protect the user. HSE Woodworking Information Sheet 12[16] gives enough information for any school wishing to try the procedure.

Attempts to use this technique have shown that, in practice in many school workshops, space is so tight that a dust lamp is very difficult to use. Machines are often so close to walls that it is impossible for either the lamp or the observer to be positioned to achieve the required angles. A further problem arises because many educational workshops have good natural lighting and no blinds. The most practicable way of doing the test is to wait until the winter and use the lamp at dusk, which may present problems for school staff.

The HSE web site www.hse.gov.uk/lev/processes/ contains video clips of flood lamp tests on a number of LEV systems. These clips show clearly how fumes and dust are emitted from a range of processes.

Although measuring the quality of the air is not easy, a good indication of the effectiveness of an LEV system used on wood dust can be gained by checking the amount of dust on horizontal surfaces around the machines and observing any dust in the air whilst a machine is in use. Whist a dust lamp can be used for this it is often possible to see the dust in the air in sunlight or in normal artificial light.

If there is dust on horizontal surfaces or it can be seen in the air then the system is unlikely to be working effectively. CLEAPSS has come across examples where teachers and technicians have complained of dust in the air and about the room but have been assured by a person testing the system that it meets requirements. Where dust exists this is clearly not the case. Such reports should not be accepted, and air quality testing should be insisted upon.

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15 The picture is taken from *Assessment and Control of Wood Dust: Use of the Dust Lamp*, 1997, HSE Books, WIS12. Free publication.

16 *Assessment and Control of Wood Dust: Use of the Dust Lamp*, 1997, HSE Books, WIS12. Free publication.

4.2 Measurements of air flow

Irrespective of the contaminant that the system is designed to remove, the performance of LEV could be monitored by measurements of the flow of air through the system. It may be necessary to confirm the direction of flow, since the measuring instruments are often insensitive to it, by the use of a smoke pencil[17] which will also help to indicate the presence of eddies or other turbulence.

Measurements of flow rate

There are two types of anemometer that are used for measuring air speeds. A **vane anemometer** has a very lightweight vane (which looks like a fan). This is held perpendicular to the flow so that the air pushes the vane around at a rate dependent on the speed of the air. The instrument is calibrated to give a direct reading of the air speed. In order to give an accurate reading, the flowing air column must be of a diameter *larger* than that of the vane. If measurements are made of the speed of the air flowing into a large aperture hood, several readings must be taken at different places so that an average speed can be calculated. The calibration of the anemometer should also be checked periodically[18]. The volume flow rate can be calculated by multiplying the speed by the area of the aperture or duct.

A **hot wire anemometer** has a small probe, a few millimetres across, containing an electrical component (perhaps a wire filament) which is heated by an electric current flowing through it. If this is placed in an air current, the component is cooled by the air-flow, its electrical resistance changes and the voltage across the component then depends on the flow rate. Again, the instrument is calibrated to give a direct reading of the flow rate. In this case, an accurate reading can be obtained for the air flowing through a narrow slot, provided the calibration is checked periodically[19]. Again, if this instrument is used to measure the flow rate into a large aperture hood, an average rate should be worked out by taking several readings at different places.

Hoods vary enormously from the very small aperture of a pipe attached to an individual soldering iron to the mesh wall of a spray booth. Vane anemometers will only give accurate, mean flow rates for large apertures[20] (e.g. fume cupboards in a science department[21]). Their use is *not appropriate* for very small apertures, i.e. those for which the inlet area of the hood is much smaller than the area of the vane. It is however possible to obtain small vane anemoneters that will measure the air flow in the ducting typically found in school and college systems and these can be effective although an instrument with a small probe is therefore required for many flow-rate measurements in design & technology[22].

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[17] See PS62 for suppliers of smoke pencils. NB: The smoke is often highly corrosive and the smoke generator must be resealed after use. Choose types based on acetic acid if possible.

[18] A vane anemometer is an electromechanical device and its accuracy depends on the friction in the pivots remaining unchanged. Annual recalibration is recommended by the manufacturers but, in practice, the need for this will depend on how much the instrument is used. If there is any question over the readings produced, the anemometer should be recalibrated. In many cases, however, where similar values are obtained when tests are repeated and there is no evidence to suggest that calibration has drifted, recalibration can be deferred until it is thought to be necessary.

[19] This type of anemometer is even less likely to drift than the vane type but the manufacturers still recommend an annual recalibration. See the comments in footnote 2.

[20] A vane anemometer, suitable for air-flow measurements in large aperture hoods, is listed in PS62.

[21] Vane anemometers used by a science department need to be accurate at an air-flow rate of 0.3 m s^{-1}, a much slower air flow than will be required for the inlets and hoods encountered in a design & technology workshop. Therefore, if a vane anemometer is borrowed from a science department for measurements of flow rates in large area hoods, it is important to check that the instrument is suitable for air-flow rate measurements of 2 m s^{-1}.

[22] See PS62 for details of a suitable anemometer.

It is not very helpful to measure flow rates unless the whole system is set up for use because the flow rate will change. If a small probe is introduced into a duct, it may be possible to make a measurement without changing the duct velocity. In many systems, it is only practicable to measure the flow rate with an anemometer at either inlet hoods or outlets although some systems will have small removal plastic plugs in the ducting that can be used to insert a probe. Since outlets are usually at or above roof level, measurements at these points require safe access to heights. As a regular procedure, therefore, flow rates can often only be measured at the inlets.

A relatively low air speed (e.g. 2 m s^{-1}) is sufficient to capture most contaminants and sweep them into the duct but a higher speed (e.g. 20 m s^{-1}) is required to keep a solid contaminant suspended in the air flowing along a duct[23]. This is normally achieved by having a hood with a larger area of cross section than that of the duct, with a tapered section to join the hood to the duct. To achieve a ten-fold increase in linear velocity, the area of cross section of the duct must be one tenth of that of the aperture of the inlet hood. If the flow rate is measured at the inlet, the flow rate in the duct can be estimated by multiplying the measurement by the ratio of the areas.

In practice, once the system has been installed, it should be given a commissioning test by the installer (see section 6.1), using a dust monitor or other contaminant test, as appropriate, to show its effectiveness. The values of the input flow rates should be recorded. In any future tests, a 10% change from these initial readings would indicate a problem in the system. If the system fails the commissioning test, its design must be re-evaluated and the necessary modifications made so that the system is proved to be effective.

Measurements of pressure in ducts

The measurement of the static pressure[24] in ducts can locate a restriction to air flow and indicate the nature of any problem. The instrument used to measure the pressure should be calibrated in pascal and a range of 0 to 5000 Pa may be required, with the ability to discriminate changes of 5 Pa between 500 Pa and 5000 Pa[25]. Test points could be provided close to each inlet, either side of any dust collector or filter unit and before and after the fan. If the pressures are recorded when the system is performing satisfactorily, changes will indicate blockages or faulty fans.

Problems with this method arise when the ducting, etc, is in an inaccessible location. However, test points can be permanently attached by the use of inexpensive plastic tubing to provide connections at more accessible positions for regular monitoring.

Pressure measurements can also be used to determine the air velocity in ducts if a pitot-static tube[26] can be introduced without disturbing the air flow significantly. This, however, requires a sensitive (and expensive) manometer and some specialist skill in operating it. It is rarely used and would normally be inappropriate for use by school staff.

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23 See C*ontrolling airborne contaminants at work, 2008*, HSG 258, 2008, HSE Books, ISBN 97807176162982.

24 The static pressure is the actual air pressure, i.e. not increased by the motion of the air. It is measured via an aperture parallel to the air flow. If the aperture is at right angles to the flow, measurements of the 'total pressure' are possible; the sensor for measuring this is called a 'Pitot tube'. The difference between these two pressures is the dynamic pressure due to the motion of the air, from which the flow velocity can be calculated.

25 See PS62 for details of a suitable digital micromanometer.

26 A Pitot-static tube allows the measurement of the total and static pressure at the same position. The dynamic pressure is the difference between the two. It is normally used with a manometer, which indicates the difference between these two pressures and therefore gives the extra pressure due to the air flow.

5. Manufacturers or suppliers of LEV

Dust- and fume-control equipment is available through different routes: general suppliers of equipment for D&T or specialist manufacturers and installers. While general suppliers may offer components at keen prices, they are unlikely to be able to design or recommend the best system for a customer's needs and provide a proper commissioning test after installation. Specialists who are likely to provide a full service are listed in the separate CLEAPSS document PS62, *LEV in Design & Technology: Suppliers, Testers and Monitoring Equipment*. This is likely to be regularly updated, so readers should check for the latest issue.

Specialist companies offering a full service should be asked to provide:

- a commissioning test with air sampling to demonstrate the effectiveness of their equipment, whether designed to cope with fumes or dust;
- a manual covering the equipment's maintenance and use, including a maintenance log, and/or
- training in the equipment's use.

As with any other contractor, the client should attempt to determine the competence of the company to be contracted to do the work. The HSE has provided a list of suggested questions[27] but the most significant ones to ask here are given below.

- What experience does the company have in the type of work required?
- What qualifications and skills does its employees have?
- Does the company have any independent assessment of its competence?
- Is the company a member of a relevant trade or professional body?

Care should be taken in the purchase of off-the-peg units to see that they will properly control the contaminate. There are instances of schools wasting money on the purchase of inappropriate equipment that fails to provide adequate control. A better course of action would be to approach a specialist company who can provide the appropriate level of expertise and to check that that any specification produced by a company meets the criteria given in section 2.4.

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[27] *Use of Contractors - a joint responsibility*, HSE 2002, HSE Books, ISBN 0717625664.

6. Recommended test methods

It is not sufficient just to test a dust-collection system with measurements of pressure or air-flow rate; measurements of dust concentration must be made under standard conditions of use. Once the system has been shown to be controlling the dust adequately, air-flow measurements can be used to confirm that it is still doing so, provided the materials used, and the process, have not changed substantially. Therefore the test results should be compared to the original commissioning test to see that the standard of extraction is being maintained.

It is important for schools to keep copies of all test reports, whoever has done the tests, for at least 5 years. The D&T department should always be given a copy of the test report. Someone in the D&T department must know where they are filed; an inspector from the HSE could ask to see them.

6.1 HSE guidance on thorough examination and test

Guidance for the 2002 *COSHH Regulations* does not ***require*** that a **dust monitor** (see section 4.1) be used in the commissioning test of a new dust-control system to confirm that, *under the most severe conditions of use*, the system is keeping the airborne dust concentration below the WEL. Nevertheless, it is difficult to see how the system can be proved effective without doing so. The commissioning test should be repeated if the conditions of use, or the work being done, change (e.g. the introduction of MDF where natural softwood had been used before). However, other simpler tests (e.g. of air-flow rates and/or measurements of static pressures) are likely to be sufficient to show that the system is still performing satisfactorily, where there is **no change of use**.

Companies offering a testing service have been able to apply for some time to the United Kingdom Accreditation Service[28] for accreditation under UKAS RG4 to show that they supply a quality service. The British Occupational Hygiene Society offer two relevant training courses, P601 & P602. Any company offering a testing service should meet the standards of competence of RG4 even if it is not formally accredited. In any case, it is wise for those using a company offering a testing service to assess the competence of the contractors by asking them to answer certain questions (see sections 5 and 8).

HSG 258 Controlling Airborne Contaminants at Work contains a section on what should be tested and the types of test to be applied. There is also a sample test form. This information is included in Appendix 2. When new systems are installed, a commissioning test should be carried out and the system checked to see that it conforms to the design specification. A copy of the commissioning test should be included in the user manual and this should be used as the reference point for the subsequent annual COSHH test.

6.2 Test methods for systems controlling wood dust

First-choice procedure: Dust-level measurements

An aerosol dust monitor, used by a trained operator to measure the dust concentration in the breathing zone of the operator, will give the most confidence that the dust levels are well below the WEL. If this is done at 14 month intervals (as required by the *COSHH Regulations*) *while the most dusty process is being carried out*, the employer can demonstrate that the requirement is being met to ‘keep the dust levels as far below the WEL as is reasonably practicable’. This test method will ensure that the control is maintained even if the process or materials change. Records of the air-flow rates at inlets (and in the

[28] Visit the web site www.ukas.com for further information about the work of this organisation.

ducts by calculation), and static pressures before and after filters, will be useful in future tests to identify faults or blockages.

However, the instruments used to perform these tests are expensive to buy and, when necessary, to maintain. Trained personnel are needed and the tests take a long time. Consequently, measuring dust levels will be expensive. It is impracticable for most individual establishments to reduce costs by doing dust-level tests themselves but some local authorities operate such a system.

Second-choice procedure: Flow-rate / pressure measurements

If a dust-control system is given a thorough test as above **once**, either on installation, as soon as it has been brought into full use or on introduction of a proper testing regime (the commissioning test), the records of the air-flow rates and/or static pressures can be used in future tests. As long as the processes and materials used remain the same, future tests of the flow rates and/or pressures will indicate whether or not the system is still behaving in the same way. Such tests could be carried out by trained school staff supplied with appropriate equipment.

6.3 Test methods for systems dealing with fume extraction

As with dust control, ideally, the system should be shown to deal with the fumes by testing the concentration of the contaminant in the air being breathed. In many situations, the major contaminant is carbon dioxide, which has a relatively high WEL value, i.e. the concentration can be allowed to rise considerably before it becomes hazardous. If all the carbon dioxide is not being collected by the fume-extraction system, the general ventilation of the workplace will dilute it and help to sweep it away. Measuring the carbon dioxide level is therefore not a very effective test of the collection system. A smoke pencil provides a reasonably effective check of these systems.

The other contaminants are released either at low concentrations (e.g. carbon monoxide) or in short bursts (from the degassing tablets used when melting aluminium). Consequently, tests of the effectiveness of fume-control systems have usually been done using special tracer gases such as sulfur hexafluoride (which can be detected at low concentrations). However, this is inappropriate as a regular test of a school or college system since supplies of the gas and expensive detection equipment are required. Nevertheless, research being done by the HSE using this technique should enable a simpler testing method to be devised. This has not yet been published so most testing companies adopt a rule-of-thumb, minimum *duct* flow rate of 10 m s^{-1}. The air speed at an inlet will depend on the ratio of the cross-sectional areas of the duct and inlet. It is the inlet air speed that is easiest to measure. However, this is not regarded as relevant by the HSE.

Temporary procedure

The only practical way of testing a fume-extraction system is to compare the air speed and/or pressures at the various **inlets** with those recorded during a commissioning test after installation. However, it is important to ensure that the settings of controls (fan speed, if a regulator is fitted, and dampers to control air flow) are the same during the retest as they were during the commissioning test. (It is unusual for wind speed to affect the results unless the workshop is in a very exposed location. In such cases, it is important to check that the discharge is via a vertical stack.)

7. Maintenance requirements

The requirement to control dust concentrations in the air applies just as much to maintaining the LEV system as to the normal uses of the dust-producing equipment.

7.1 Emptying dust containers

Problems

Some systems collect dust in ‘drawers’ at the bottom of the extraction unit. When the drawer is opened the dust can easily be disturbed by air currents and carried up towards the breathing zone of the person emptying it.

In other systems, the dust is collected in plastic bags so that, when they are sufficiently full, the top of the bag can be released and sealed with minimum risk of disturbance to the collected dust. Clearly, this is much safer than handling a drawer containing dust.

Further potential problems occur once the bag or drawer has been removed. The practice of emptying the drawer into a dustbin or into a wheelbarrow, which is then taken outside the workplace and tipped into an open skip, is unacceptable for three reasons.

1. There is a high risk of releasing the dust back into the workplace.
2. There is a high risk of the person carrying out the task inhaling the dust.
3. Dust blowing out of the open skip presents a hazard to passers-by or to neighbours.

Where plastic bags are used, they should be heavy-duty to minimise the risk of tearing and releasing dust. However, these are relatively expensive and, to save money, D&T staff have been known to take full bags outside and empty them into skips or other containers so that the bags can be reused. This is unacceptable for reasons 2 and 3 above.

Some educational establishments have offered collected dust to those keeping small mammals, as litter for their cages. Although some dust-collection systems claim to separate fine dust from shavings and coarse dust, such separation is not perfect. Animal litter should be ‘dust free’ and not contaminated with chemicals used to preserve wood or potentially harmful hardwood particles. It is impracticable for workshops to meet these conditions and litter for keeping animals should be obtained from a supplier who can guarantee they are met.

Solutions

It is therefore important that all of the following control measures are adopted when emptying dust containers. Anyone not involved in the emptying process should be kept well away from the area.

1. The person handling loose, collected dust is provided with a toxic dust mask (also referred to as a ‘disposable respirator’). Type FFP2 is suitable for ordinary sawdust but type FFP3 should be used if there is a lot of fine dust present, e.g. from MDF[29].
2. The procedure used minimises the dispersion of the dust, e.g. the drawer can be placed in a large plastic bag before inversion to empty it.
3. The wood dust is sealed in plastic bags for waste collection.

[29] Suitable masks / respirators are available from many manufacturers and even more suppliers; examples include 3M part number 9320 and 9332. It is not possible to give guidance on the time for which one mask can be used. If the use is intermittent, care must be taken to avoid dust contamination of the inside between sessions. Note that there may be problems in providing adequate protection if the masks are worn over beards. ‘Nuisance dust’ masks must never be used, as they provide no protection at all.

Disposal of dust

The CLEAPSS document PS 31, *Disposal of waste in Design and Technology,* gives full details of the correct disposal of waste produced in design and technology. It should be noted that some types of wood waste may be considers as hazardous. The relevant section from PS 31 is given below.

"Waste from the machining of new, untreated timber would be classified under the List of Wastes Regulations 2005 as 03 01 05 - sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04. The entry 03 01 04 is sawdust, shavings, cuttings, wood, particle board and veneer containing dangerous substances. The asterisk denotes that this is hazardous waste. The term dangerous substances is interpreted to mean hazardous chemicals used to treat or cover the wood, such as preservatives but not necessarily thin layers of paint unless it is very old paint containing lead-based pigments. Wood dust which comprises only materials in 03 01 05 will not be hazardous and can therefore be disposed of in the normal refuse. Dusts and shavings in category 03 01 04* will be hazardous and will need to be disposed of by a registered waste contractor. For a bag of dusts and shavings, which contains a mix of both types of waste, it will be practically impossible for a department to determine whether the threshold of dangerous substances has been exceeded. It follows that any such mixed bag would have to be treated as hazardous waste".*

Some wood waste formed during hand operations will always end up on the floor. It should be cleared up using a 'dustless method', i.e. using an industrial vacuum cleaner or by the use of an appropriate floor-sweeping compound to prevent the dust becoming airborne. The sweepings can be transferred to a bag, correctly labelled and stored safely for eventual disposal or collection. In transferring dust and shavings to bags, make sure that the operator is not exposed to hazardous levels of dust.

7.2 Filter maintenance

Dust filters

Most dust-collection systems incorporate filters, which should be shaken periodically to dislodge dust and maintain filter efficiency. The largest systems have motor-driven shakers that operate automatically. More typical systems used in educational establishments have manually-operated shakers. The supplier normally specifies the intervals at which these should be used. These specifications often give a time in hours, e.g. 'every 8 hours' or 'once a week' which would probably be appropriate where the extraction is running throughout the working day. In schools and colleges, this is rarely true and the interval should be established by experience. If a particular system has been in heavy use, it might be necessary to shake the filter at the end of the day to prevent its performance deteriorating, otherwise once a month could be sufficient.

Disposable paper filters are used in some systems to collect the finest dust. These *should* be changed at the frequency suggested by the supplier. If this is not done, the performance of the system can fall off significantly such that replacement of the filter produces an obvious improvement in the air-flow rate. Similarly, washable, fabric filters or bags should be washed at such intervals that the clean one produces a change in air flow that is only just detectable without instruments.

Fume filters

Systems to control fumes usually exhaust to the open air without a filter. An exception is the type used to deal with fumes from soldering with rosin-based fluxes in electronics work. These use filters that should be changed at intervals, as specified by the supplier. Extraction systems used with laser cutters will also use filters and it is essential that these are also changed at intervals as specified by the supplier. Some filter units will have a display that will show when the filter has to be changed and this should be used.

7.3 Informal checking

The annual thorough examination and test required by the COSHH regulations will ensure that once a year an LEV system is in effective working order. However it is possible for the performance of LEV systems to deteriorate over time and it is important that users of LEV systems carry out more frequent informal checks to ensure that the contaminants are adequately controlled. This is particularly important for LEV systems designed to extract wood dust and shavings because they can become blocked. The HSE currently recommends the fitting of air-flow indicators so that routine checking is made relatively easy. Where such indicators are not fitted there are a number of simple checks that users can carry out without the need for formal training. These are described below.

a. Visual inspection

- Check closely all parts of the system for damage, wear and tear, such as, splits in flexible ducting, holes in collection bags (where fitted), missing or loose bolts or other fixings, missing blast gate sliders.
- Check ducting for blockage caused by slivers of wood. This is important where dust is collected next to saw blades because plastic cowlings may have small exit points that are easily blocked.
- Check ducting is still connected to the machine and has not worked loose.
- Check any necessary filter cleaning devices work correctly.
- Check for overall effectiveness – e.g. look for deposits of dust in and around hoods or other parts of the systems, dust on top of machines or horizontal surfaces near to machines, excessive vibration or noise.
- Check and clean inside machines, e.g. band saws and the base of circular saws for a build up of dust. This is an indication that the system may not be working.

It is suggested that visual inspections of the type described above should be done at least weekly during term time, and for machines with heavy use daily would be more appropriate. The chosen interval should be recorded in the log book.

b. Other checks

- A good test that dust extraction working effectively is to hold some sawdust in the palm of one hand and see if the collection hose or extraction point will collect it. Repeating the test and moving the hand further away from the collection point will give an indication of effectiveness. Obviously, care should be taken not to do this near to rotating blades or cutters. If the dust is not collected effectively then it is an indication that the system is not working as intended and further investigation should be carried out. A similar check can be done using a strip of plastic cut from a plastic carrier bag. These tests will only give a qualitative indication of effectiveness.
- If any faults are suspected, test the flow rate using either a vane anemometer or a hot wire type as described in section 4.2.
- Alternatively, a dust lamp test, as described in section 4.1, could be used

7.4 Tips for good housekeeping

It is important to realise that dust can deposit within inlet hoods, inside band or circular saws or on bends in ducting (especially flexible ones) and seriously affect the performance of the system. In extreme cases it has been known for dust to accumulate to such an extent that the duct or hose can be totally blocked. If the problem points can be identified, regular brushing can eliminate the problem, if there is an access port. If access points are not provided then parts of the extraction dusting may have to be dismantled. This should not be a problem since blockages are most common where there are bends in flexible ducting which are usually secured by large hose clips. (If this releases dust into the workshop, the person doing the brushing must use a vacuum cleaner **suitable for the collection of dusts**[30] or wear a toxic dust mask as discussed in 7.1, with nobody else nearby.)

Where systems incorporate dampers to maximise the air-flow at the inlet in use, it is essential that the user appreciates how the controls must be used. This implies a need for training in the use of the system, together with a guidance sheet or users' manual and reminder notices near machines.

Cleaning

Even with an excellent dust-collection system at each machine, there will still be dust produced, for example, by hand sanding or dust which escapes at each machine. Cleaning in a workshop is not a trivial activity, because wood dust has been given a WEL and the employer is required to keep its concentration as low as reasonably practicable to protect the health of cleaning staff, as well as of D&T staff and pupils.

Some establishments do not include wood-preparation and storage areas in cleaning schedules. If regular cleaning staff do not service these areas, other arrangements must be made to ensure that the health of the person doing the cleaning is safeguarded.

Traditional cleaning methods using brushes and mops are **unlikely** to be suitable, even if cleaning staff are required to wear appropriate dust masks. The only effective method is to use a vacuum cleaner that is **designed to collect wood dust**; (a 'general-purpose' vacuum cleaner is unlikely to be suitable because it will not trap the fine dust involved). Usually an industrial quality vacuum cleaner is required that is fitted with a HEPA (High Efficiency Particulate Air) filter that will prevent fine dust form being released into the air. Since the waste is likely to include small offcuts as well as dust, a variety of nozzles will be needed. Cleaning staff *will need training and supervision* to ensure that the specialist vacuum cleaner is used where it is required (and not generally throughout the school) and that it is emptied according to the manufacturer's instructions, using similar care to that described in section 7.1. There is some risk in pupils brushing dust from workbenches at the end of a lesson. CLEAPSS is not aware of any regulations which state that hand brushing should not be used but it is advisable not to allow fine dust to be brushed off a bench.

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[30] Refer to the separate document, PS62, *LEV in Design & Technology: Suppliers, Testers and Monitoring Equipment*, for details of companies that supply suitable vacuum cleaners for dust collection, for example, Depureco, Dustcontrol UK and Nilfisk. PS62 will be regularly updated, so readers should check for the latest issue.

8. CLEAPSS advice

8.1 The provision of air flow indicators

The HSE web site www.hse.gov.uk/lev/faqs.htm contains very useful information on issues related to LEV and the first question, in relation to the fitting of air flow indicator is quoted below.

> **Do I have to fit air-flow indicators to all the hoods in the LEV system?**
>
> There isn't a specific legal requirement to have air-flow indicators or similar fitted to an extraction. But as an employer you do by law have to make sure your LEV system keeps working properly. One of main reasons why LEV doesn't do what it should is because the airflow falls for some reason (e.g. build-up of material, damage to ducting etc), becomes inadequate and effective control is lost.
>
> One simple way of checking this is the use of air-flow indicators (or a static pressure gauge) at the hood and this will provide you reassurance that the flow-rate is maintained, that the protection for employees is there and that you're not wasting money. There are other ways of checking air flow such as using anemometer, or a dust-lamp or smoke tracer (with the work process running). However, an air flow indicator (or static pressure gauge) is currently the only method that will show the operator or supervisor immediately if there's a problem, and the HSE's LEV guidance HSG 258 recommends these are fitted.

At the time of writing, the CLEAPSS view is that in schools and colleges it is not necessary to fit airflow indicators to every extraction point, but staff working in educational establishments do need to ensure that the systems are working correctly. CLEAPSS would advise that airflow indicators should be fitted to LEV dust extraction systems in D&T preparation rooms since these rooms are used by technician and teaching staff who will know how to monitor the airflow. Indicators should be fitted to each extraction point or, if separate extraction units are used, to each unit. To spread the cost of this over a reasonable period of time (e.g. 2 years) the work could be done according to a written action plan so that the intent to take action is clearly documented.

CLEAPSS believes it is not appropriate to fit airflow indicators to dust extraction points in workshops used by pupils because the pupils are unlikely to have the necessary expertise and experience to adjust blast gates. We advise that D&T department obtain a suitable hot wire anemometer and use this at intervals to check the air flow in LEV systems in workshops and compare the readings with the data obtained from the annual inspection and test. The suggested testing interval is once every four weeks during tem time. In further education colleges where wood machining workshops may be present and where students who enter the woodworking industry are trained, then it would be sensible to fit an air flow indicator to every extraction point, since this would provide a valuable teaching opportunity. In general, LEV systems used for fume extraction from hot metal areas do not have such heavy use as those used for dust extraction and we feel that airflow indicators are not needed for these systems in schools. In further education colleges where such systems may have more extensive use, and in welding workshops in such colleges, the CLEAPSS advice is that air-flow indicators should be fitted.

8.2 What employers' representatives[31] should do

1. Confirm that dust- and fume-control systems are provided in the workshops. If not:

- draw up a specification for the LEV needed for each situation (ensuring that it meets the criteria listed in section 2.3.1 and that the recommended maximum noise level, 65 dB(A), for a teaching workshop is not exceeded), bearing in mind the most hazardous operation carried out at each location;
- obtain several quotations from different suppliers;
- ensure that each quote includes provision for a commissioning test using a dust or fume monitor and measurements of flow rate or pressure (and the resulting noise level) during the operation specified;
- ensure that, following installation, training will be provided on how the system should be used and maintained; and
- reject any quotes which do not include hoods specific to the machines involved.

2. Where dust- and fume-control systems *have* been installed, determine whether records exist of tests performed on this equipment.

3. Check to see whether these records show that dust or fume concentrations in the breathing zone of an operator have ever been measured and which processes were being performed during the measurements.

4. If no records of tests exist, arrange for concentrations of dust &/or fumes to be measured by a contractor or a trained employee.

5. Decide whether it is necessary to repeat these tests annually or whether annual tests of air-flow rates and/or pressure changes are sufficient.

6. Make arrangements for the annual tests either by contractors or trained employees.

7. Follow up the test results with any necessary remedial measures and retest if appropriate. Such measures could involve:

- retraining staff to use correctly the LEV systems provided, and documenting how the systems work, for the benefit of future staff;
- repairing hoods, ducting and filter housings;
- maintaining dampers (blast gates) and fans;
- replacing filters or control systems;
- fitting explosion-relief panels on dust collectors. (a panel which acts as a safety valve in the dust collection unit. It is designed to blow out under excess pressure)

8. Ensure that workshop cleaning staff are provided with appropriate types of vacuum cleaners and are trained to use them correctly.

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[31] For community and voluntary-controlled schools, the employer is the local authority. For foundation schools, academies, city technology colleges voluntary-aided and independent schools, and for sixth-form and further education colleges, the employer is the governing body (or possibly a trust or the proprietor). For local authority schools, the employer's representative may be a health & safety officer, D&T adviser, or other official. In other establishments, it may be the bursar or other person given the duties of overseeing general health & safety matters.

9. Ensure that arrangements are made for disposal of dust in accordance with the regulations on waste disposal (see CLEAPSS publication PS31, *Disposal of Waste in Technology*).

10. Ensure that all records of tests and action taken are filed in a *readily-accessible* place at the school or college, with copies filed centrally (for LEA establishments).

11. Ensure that arrangements are in place to discharge the employer's duty to monitor that dust- and fume-control systems continue to work correctly.

8.3 What a head of department should do

1. Determine whether the establishment holds records of tests of individual dust- and fume-control equipment.

2. Report to the employer's representative that tests will be due before the date 14 months after the last test.

3. Consider the processes involved: which produces the most fine dust (probably sanding MDF) and which produces the greatest amount of fume (probably adding degassing tablets to a crucible of molten aluminium).

4. Draw to the attention of the employer's representative the need to have tests on LEV systems *when the processes identified in 3 are in progress*.

5. If the employer arranges for flow-rate or pressure measurements to be made, the head of department must know what is expected and be able to confirm that the tests have been done.

6. Ensure that all staff know how to use the dust- and fume-control equipment correctly, providing instruction where necessary, and documenting this for the benefit of future staff.

7. Arrange for frequent (e.g. weekly) visual checks of machines / systems with LEV to ensure that off-cuts, chippings or other deposits have not choked the inlet and prevented extraction from working normally. On some systems, these checks will require the removal of inspection panels and an appropriate dust mask might have to be worn (see section 7.1). This should include completion of the record book supplied with the equipment.

8. Report to the employer's representative any defects that become evident between tests or any changes in machinery or procedures which may require different collection hoods or even different filtration equipment to be installed.

9. Report any symptoms shown by staff (or others) which might indicate inadequate control of dusts or fumes (e.g. respiratory or skin irritation problems).

10. Liase with cleaning staff to ensure that vacuum cleaners can be used effectively (e.g. by reducing clutter) and report any defects in cleaning to the person in charge.

8.4 What all staff should do

1. All staff must cooperate with the employer. E.g. under *COSHH Regulation* 8 (2), it is a criminal offence to omit to use the LEV system provided (if the risk assessment requires it) or not to wear a mask provided for use when emptying dust containers.

2. Once each day, or every time a machine is operated, a simple check should be used to confirm that the LEV is working, e.g. by holding a strip of paper or flexible plastic where the air flow should produce a deflection.

3. Under *COSHH Regulation* 8 (2), staff are required to report defects in safety systems, hopefully **before** such defects give rise to significant hazards. The reporting system should be such that dated copies of reports are retained at least until the fault is dealt with.

4. Staff are also expected to report any health problems which might be related to conditions at work, for example, blocked sinuses, excessive eye watering or other hay-fever-like symptoms.

5. Staff are expected to ask for instruction or training if it becomes necessary[32], e.g.

- when new processes or materials are introduced, or
- when new staff are appointed.

[32] There is a serious shortage of training facilities and services for D&T nationally. The Design & Technology Association (DATA) is trying to rectify the situation.

9. Suppliers' addresses

This guide, L225, is accompanied by the publication PS62, *LEV in Design and Technology: Suppliers, Testers and Monitoring Equipment,* which contains the contact details for LEV contractors and other companies mentioned in this guide. PS62 will be updated as details change or new suppliers are identified. Please contact CLEAPSS or check on the D&T resource part of its web site (www.cleapss.org.uk) for the most recent version of PS62, which can be downloaded. For password details look in the spring term Bulletin, contact the science department or e-mail CLEAPSS at password@cleapss.org.uk.

Appendix 1: Glossary of terms

Anemometer. An instrument that measures air speeds. Two different principles are used: the cooling effect of the air flow on a heated component (which might be a hot wire filament or a semiconductor) and the mechanical effect of the air flow on a light vane which can rotate or be deflected.

Approved code of practice. An Approved Code of Practice (ACOP) for a set of regulations made under the *Health and Safety at Work Act* includes the regulations themselves, interpretation of those regulations (marked ACOP in the margin) and often further comment from the HSE. Sections marked ACOP have a special legal status. In a prosecution for breach of health & safety law where it is proved that the Code has not been followed, the court will find the defendant guilty unless the defence can show that the law has been met in some other way.

Blast gate. Another name for a damper when used as an on/off control in an LEV system.

Capture velocity. The capture velocity for each contaminant is the air speed necessary to draw the contaminant into the inlet of the LEV system.

Carcinogen. A carcinogen is a substance that has been identified as being capable of giving rise to some form of cancer in humans. There are three categories of carcinogen:

1. substances known to cause cancer on the basis of human experience;
2. substances which it is assumed can cause cancer, on the basis of reliable animal evidence;
3. substances where there is only evidence in animals which is of doubtful relevance to human health (i.e. the evidence is not good enough for Category 1 or 2).

(Category 1 and 2 carcinogens carry the risk phrases R45 ‘May cause cancer’ or R49 ‘May cause cancer by inhalation’. Category 3 carcinogens carry the risk phrase R40 ‘Limited evidence of a carcinogenic effect’.)

Further discussion on these is contained in Section 7.8 of the CLEAPSS *Laboratory Handbook*, held by science departments.

Chemical sampling tube. Used to measure the concentration of a chemical pollutant that is drawn through the tube by a pump (hand-operated or powered). The concentration is shown by means of a colour change of an indicating material in the tube.

Colophony. A commonly used flux for soft soldering which has been identified as the cause of health problems in some users. It is also known as rosin.

Contaminant. Contaminants are the substances hazardous to health that the LEV system is required to remove or control. In a typical workshop, these include particles of wood or metal, dust, mist, smoke, fume, vapour and gas. See Table 1.

Damper. A shutter which can be used to regulate the air flow through part of a ducting system, particularly where air flows through several inlet hoods. The setting is used to balance the flow so that efficient collection is achieved at all inlets or at the particular hood in use.

Duct velocity. The duct velocity is the average air speed in the duct. It should be greater than that required to keep the contaminant flowing in the duct and prevent it from falling out of the flow under the influence of gravity.

Dust mask. A mask designed to reduce the inhalation of dust. There are several different types.

1. A nuisance dust mask consists of a layer of cotton gauze often held in place by a light-weight metal frame. It is **ineffective against toxic dusts**.

2. Toxic dust masks may be disposable, half- or full-mask respirators, light-weight powered visors or helmets. They have filters of different types for different dusts. (See HSE *Woodworking Information Sheet* No. 14 for more details.) The disposable types, likely to be most relevant to education, have the filter type EN 149 FFP2 and 3. They must be worn when changing / emptying dust-collection bags / drawers.

Dust monitor. An instrument designed to measure dust concentrations in the air. Those types giving immediate readings measure the light scattered from air samples passing through the instrument.

Duty. A duty laid on anyone by the *Health and Safety at Work Act* cannot be delegated. The employer cannot argue that because the health and safety budget has been delegated to a particular section or person that the employer has discharged its duties under the Act.

Filter. A device to separate the contaminant from the air flow. It often consists of sheets of perforated card, a fabric bag or both. Paper filters are used to catch fine dust and these need regular replacement. Large systems may include a cyclone in which the contaminated air is caused to flow in a circular path with the higher-density contaminant flung outwards.

Hood. The hood in an LEV system is the entry point to the system. It is a device that encourages the contaminant to enter the air flowing into the duct.

HSE guidance. The Health and Safety Executive (HSE) supplies guidance in several different forms. Information Sheets are short, single-topic documents which are free, as single copies. More extensive guidance is given as specific publications and official guidance on regulations in Approved Codes of Practice (ACoPs). All of these are available from HSE Books. Free leaflets can be downloaded from the HSE web site: www.hse.gov.uk.

MDF. The common abbreviation for medium-density fibreboard. This is a composite material of wood particles bonded with urea-formaldehyde resin. The precautions to be taken when using this material are discussed in CLEAPSS publication PS33, *MDF*. Some dust-control systems, which are adequate for ordinary sawdust, may not be able to control the fine dust from MDF. However, provided that **adequate** control measures are in place, there is no reason why MDF cannot be used in educational establishments.

Model risk assessments (MRAs). A collection of generic risk assessments for a group of activities or typical activities that can be used, with minor adjustments, to form risk assessments for the actual activities. See the publication *Model Risk Assessments for Design and Technology in Secondary Schools and Colleges* (2009) (only available to subscribers) published by CLEAPSS. The latest version of the Model Risk Assessments was published on the CLEAPSS web site in September 2009.

Occupational Exposure Limit. OELs have now been replaced by WELs. (See below.)

Personal Protective Equipment. Personal Protective Equipment (PPE) consists of items such as protective aprons, boots, gloves, goggles and masks. These should be used as 'last-resort protection' if other precautions fail or are impossible to use.

Pitot-static tube. A Pitot-static tube measures both static and total pressures in a duct (see below) and allows the difference to be measured as the dynamic pressure that then allows the airspeed to be calculated.

Rosin. A commonly-used flux for soft soldering which has been identified as the cause of health problems in some users. It is also known as colophony.

Static pressure and dynamic pressure. The static pressure of the air in a duct is the average pressure of the air without allowing for any change due to its motion. It is measured via an aperture whose plane is parallel to the local flow direction. If the measurement is made via an aperture whose plane is perpendicular to the local flow direction, the pressure may be above or below the static pressure. This reading is called the total pressure. The dynamic pressure is the difference between total and static pressures.

Substances hazardous to health. The *Control of Substances Hazardous to Health (COSHH) Regulations* define such substances as those which are toxic and very toxic (including carcinogenic), harmful, corrosive or irritant; any substance with an occupational exposure limit, pathogenic microorganisms, dust at a sufficient concentration and any others with a comparable health risk.

Testing intervals. All LEV which is required to meet the *COSHH Regulations* must be tested at particular intervals (Regulation 9). The most common specification is for a 14 month interval, i.e. an annual test with two months 'grace' should the test be unavoidably delayed.

Time weighting. WEL limits are subjected to 'time weighting', i.e. the actual concentration is the average value over either 8 hours or 15 minutes. It is unlikely that the average values of (for example) wood dust concentrations in an educational workshop exceed the WEL but may approach it. In that case, the level has **not** been reduced as low as reasonably practicable.

Tyndall dust lamp. A Tyndall dust lamp is any lamp with a reasonably parallel beam of light that can reveal the presence of fine dust by the forward scattering process first identified by Professor Tyndall.

Workplace Exposure Limit (WEL) A WEL is the maximum concentration to which employees may be exposed by inhalation (averaged over a certain time span). The value is not a distinction between levels that are unsafe or safe and exposure should be well below any relevant WEL value. If the substance is a class 1 or 2 carcinogen or a sensitiser, the level of exposure should be reduced to as low a level as reasonably practicable. The values of WELs for different substances are published by HSE in document EH40/2005 Workplace Exposure Limits.

Appendix 2: Testing of LEV systems

Commissioning test of an LEV system

Any new LEV system should have a commissioning test carried out after installation to ensure that it is performing as required. This also applies to any off-the-shelf system that a school or college may purchase and install itself, or which is supplied and fitted by a contractor during a refurbishment programme. Thereafter, the COSHH regulations require that every LEV system has a thorough examination and test annually, although a two month slippage period is permitted. HSG 258 contains guidance on what should be included in this.

An LEV system should also be recommissioned after any modification, or change in the way it is used. Most educational workshops will contain at least two systems, one for controlling dust, e.g. from woodworking machines, and another for controlling fumes, e.g. from hearth areas. A further system for controlling solvent fumes from painting or other operations may also be required. Each machine or workplace where significant amounts of dust are produced should have its own test. One test may be sufficient for a small system dealing with fumes or solvents.

In addition to the annual test, regular, informal checks are also required to ensure that the LEV system continues to work effectively. This is a separate process to the annual testing and should be done as required. CLEAPSS recommends that these informal checks are done at least weekly. Methods of informal testing are described in section 7.3.

If a school or college wishes to do its own annual testing, the responsible person must have suitable training and should follow the guidance given below.

Regular, thorough examination and test of an LEV system

At regular intervals, at most 14 months, each system needs a thorough examination to comply with *COSHH Regulation* 9 and prove that the system is still working effectively. These examinations will be similar, but not necessarily identical, to the commissioning tests.

We have provided below two suggested report forms to meet the needs the commissioning test and regular examination. Although the forms are copyright, CLEAPSS member establishments may make as many copies of them as necessary for their own internal use or for use by their contractors. Contractors may therefore need to see parts of this guide if they are to make sense of the report forms.

I. Suggested Report on a Commissioning Test of an LEV System

A. Description of the system

Name of establishment: ....

Employer: ....

Workshop: ....

Manufacturer of system: ....

Manufacturer's code or reference for the system: ....

Installer of system (if different): ....

Diagram of the system to be attached.

Purpose:	Tick one box:
Control of wood dust	
Control of solvent fumes	
Control of fumes from hot metal working	

Type:	Tick one box:
Fixed installation serving **all** activities simultaneously	
Fixed installation serving several activities but at a time[1]	
Fixed installation at **one** work point or machine	
Portable system serving alternative machines	
System extracting from one portable power tool	

1 Insert "only one", "up to two", "up to three", etc, in the space provided.

B. Tests

Date: .... Name of testing company / LEA officer / technician: ....

Type of test:	Tick one box:
Commissioning test	
Recommissioning test (specify reason)	

Contaminant-level test:

Most hazardous application in use:	Tick one box:
Machining MDF	
Casting non-ferrous metal	
Spraying a large item	
Other (specify)	

Conditions of test:	Insert details below:
Number of inlets open	
Machine in use	
Most hazardous application in use	

Contaminant-level test continued:

Contaminant tested for:	Detection method:
Respirable dust from woodworking	
Fluorides from casting	
Solvent fumes from surface treatments	
Chlorinated hydrocarbons	
Other (specify)	
Result: Contaminant level at operator's breathing zone is less than:	

***Either*: Air-flow measurements (for regular thorough examination):**

Anemometer used:	Make:	Model:
For small aperture inlets:		
For large area inlets:		

Machine / workplace	Machine running?	Inlet tested	Number of system inlets open	Flow rate / $m\ s^{-1}$

***Or:* Pressure measurements (instead of air-flow rate for regular thorough examination):**

Type of measuring instrument used:	Make:	Model:

The test points should include both sides of any filter and both sides of any anticipated blockage points. Where a test point is provided by means of a long tube connected to a nipple in the duct, it is important to check that the tube is unblocked before connecting the measuring instrument.

Test-point location:	Machine running?	Number of system inlets open	Static pressure / kPa
Close to top inlet / hood			
Close to side inlet / hood			
Close to machine casing			
Inlet side of filter			
Output side of filter			
Inlet side of constriction			
Output side of constriction			

C. Conclusions from examination

The following items need further attention.

1. ....

Reason ....

2. ....

Reason ....

3. ....

Reason ....

4. ....

Reason ....

D. Final result

Possible outcomes:	Tick one box:
The system is performing satisfactorily.	
The system is not performing satisfactorily as detailed above.	
The system should be redesigned, as it is unsuitable for the task. Work using the system should cease until a satisfactory replacement is installed.	

Signature of tester ....

E. Subsequent action

The following action has been taken.

1. ....

By .... Date ....

2. ....

By .... Date ....

3. ....

By .... Date ....

4. A further test has been arranged on… Date ....

By .... Date ....

II. Suggested Report on a Regular Thorough Examination and Test of an LEV System

A. Description of the system

Name of establishment: ....

Employer: ....

Workshop: ....

Manufacturer of system: ....

Manufacturer's code or reference for the system: ....

Installer of system (if different): ....

Purpose:	Tick one box:
Control of wood dust	
Control of solvent fumes	
Control of fumes from hot metal working	

Type:	Tick one box:
Fixed installation serving **all** activities simultaneously	
Fixed installation serving several activities but at a time[1]	
Fixed installation at **one** work point or machine	
Portable system serving alternative machines	
System extracting from one portable power tool	

1 Insert "only one", "up to two", "up to three", etc, in the space provided.

B. Tests

Date: .... Name of testing company / LEA officer / technician: ....

Type of test:	Tick the box:
Regular thorough examination	

Previous tests on this system:	Insert date(s):
Commissioning or initial appraisal:	
Previous regular thorough examination:	

***Either*: Air-flow measurements (for comparison with previous results):**

Anemometer used:	**Make:**	**Model:**
For small aperture inlets:		
For large area inlets:		

Machine / workplace	**Machine running?**	**Area of inlet tested / m^2**	**Number of system inlets open**	**Air speed / ms^{-1}**	**Flow rate volume / m^3s^{-1}**

***Or:* Pressure measurements (for comparison with previous results):**

Type of measuring instrument used:	**Make:**	**Model:**

The test points should include both sides of any filter and both sides of any anticipated blockage points. Where a test point is provided by means of a long tube connected to the nipple in the duct, it is important to check that the tube is unblocked before connecting the measuring instrument.

Test-point location	**Machine running?**	**Number of system inlets open**	**Static pressure / kPa**
Close to top inlet hood			
Close to side inlet hood			
Close to machine casing			
Inlet side of filter			
Output side of filter			
Inlet side of constriction			
Output side of constriction			

Tests for air quality

Type of air quality test used:	**Result**

Result of air quality test

The quality of air around the equipment was ……………………………………………………………………

…….

C. Conclusions from examination

The following items need further attention.

1. ....

Reason ....

2. ....

Reason ....

3. ....

Reason ....

4. ....

Reason ....

D. Final result

Possible outcomes:	Tick one box:
The system is performing satisfactorily.	
The system is in need of major maintenance or repair, as discussed above.	
The system should be replaced; work using it should cease until this is done.	

Signature of tester ....

E. Subsequent action

The following action has been taken.

1. ....

By .... Date ....

2. ....

By .... Date ....

3. ....

By .... Date ....

4. A further test has been arranged on .... Date ....

By .... Date ....