Monthly Meeting 14th November 2011

Presentation: Local Exhaust Ventilation – the Practicalities

Tim & Richard Prestage, Tim Prestage Ltd

Tim launched the presentation with a DVD showing common problems experienced with Local Exhaust Ventilation (LEV) systems. First there was a sanding job on softwood, shown with/without a Tyndall Beam test light. The respirable dust was invisible without the light but became strikingly obvious when illuminated. Then there was a view of a spray booth with an air velocity of 0.3m/sec that produced a 'wake' around the operative. But there was next to nothing captured in the stream. The next sequence showed the speed increased to 0.5m/sec, with the extraction affected by draught from a door and, then, greatly improved by having slotted vents at the rear of the cabinet. This arrangement, Tim added, was ideal for a welding booth!

L to R: HM Principal Inspector Malcolm Downey, HSE for Northern Ireland, Richard and Tim Prestage.

The scenario that followed illustrated the effect of fitting a cone to a hood whereby, for distances from the hood of greater than 1 diameter of the duct, in front of the face, the capturing capacity is less than 10% of the maximum. Tim added that it doesn't matter how powerful the fan displacement is! For a welding operation, he went on to say, this means that the hood as to be moved continuously with the progress of the weld to maximise the fume capture.

The DVD then went on to show some more specialist operations like disc cutters on angle grinders, dropping powder into an open-top container and soldering with resin fluxes. It is important to understand that because LEV is not efficient, it should not be used for toxic substances.

Tim commented that LEV was important because: -

- It removes harmful, dusts, fumes vapours, and gases from the breathing zone of the operator.
- It is a legal requirement under the COSHH Regulations.
- The equipment is often not properly understood by employers. Tim commented on this issue that there were not many manufacturers in the West Midlands so that supplier's representatives were more likely to be

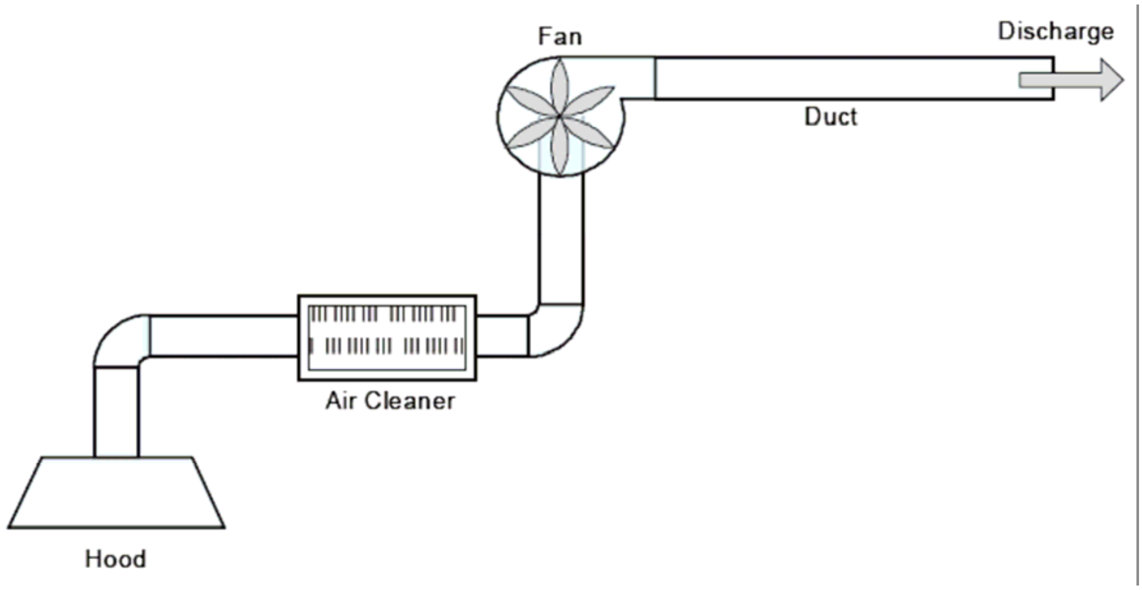
of the ‘Sales persuasion’, rather than the designer/engineering types anticipated in HSE guidance!

The function of an LEV system is to: -

- Collect or contain the airborne contaminant.
- Carry it away from workers for treatment or discharge to a safe place.
- Ensure adequate control of exposure and below relevant Workplace Exposure Limits (WEL).

It is important to note, he commented, that loss of LEV control can lead to ill health!

The basic elements of any LEV system are: -

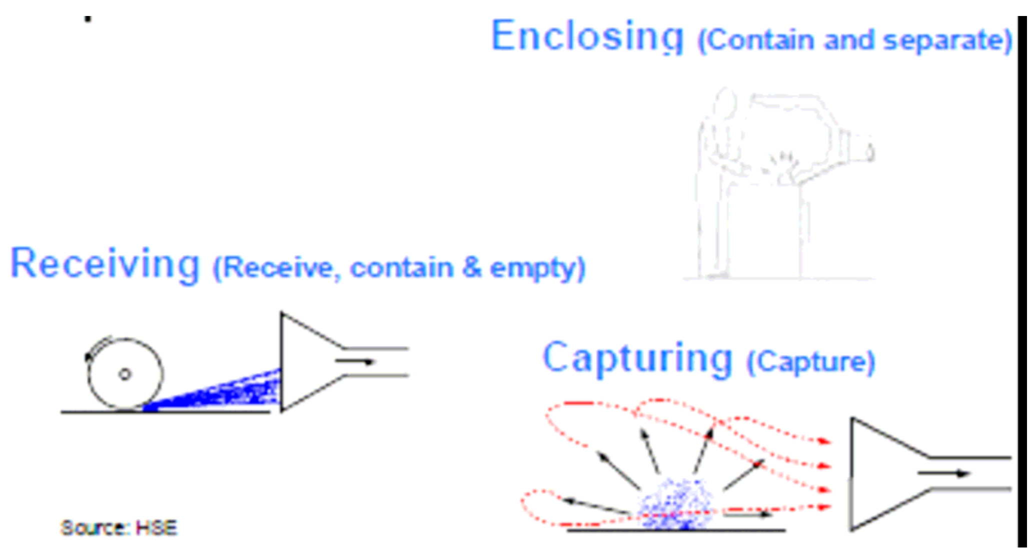


Typical LEV Schematic Diagram (Permission of Adrian Hirst)

LEV can be used for a range of contaminants: -

- Dusts and Fumes) These might be classified as harmful, irritants,
  Mists and Fogs) or corrosive.
- Vapours and Gases) LEV is not suitable for highly toxic materials, however,
- Aerosols and Smoke.) as it is not 100% efficient.

Tim continued by commenting that there are three basic types of hood: -



Tim added that enclosures came in a variety of guises, ranging from gloved boxes, through to spray booths, up to room types like vehicle spray production lines. The most critical part of any system, he said, was the hood, which was very often not of the correct type and didn't match the process and source of contamination. There was often insufficient airflow, caused by blockages of various types, and the contaminant is not contained or captured. Such system designs would never have provided adequate protection!

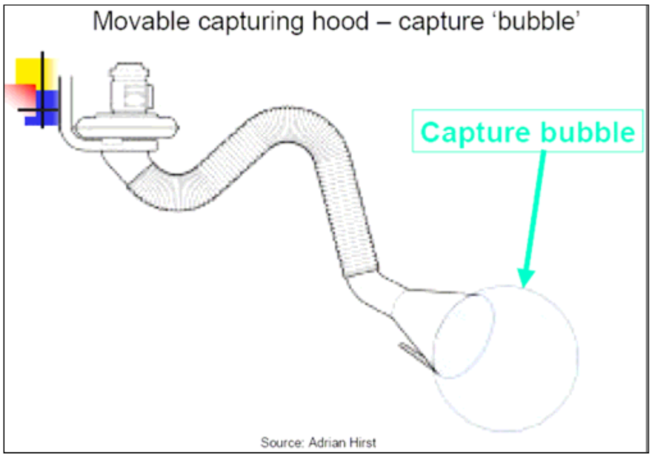
As an example of differing design requirements, Tim quoted extraction of vapour from an open drum that needed a side-capture extraction hood with an air velocity of 0.5 m/sec across the top surface. If the drum was being filled from a pipe above, however, then the capture velocity has to be increased to 2.5 m/sec, to combat the air turbulence created by the process. In other situations, like sanding, woodcutting or angle grinding, a good solution would be to use a 'downdraught' bench that uses the natural flow of the contaminants to reinforce the extraction stream. This has a variable speed and is an inherently quiet design.

Tim gave further guidance on selection of LEV for various processes in this table: -

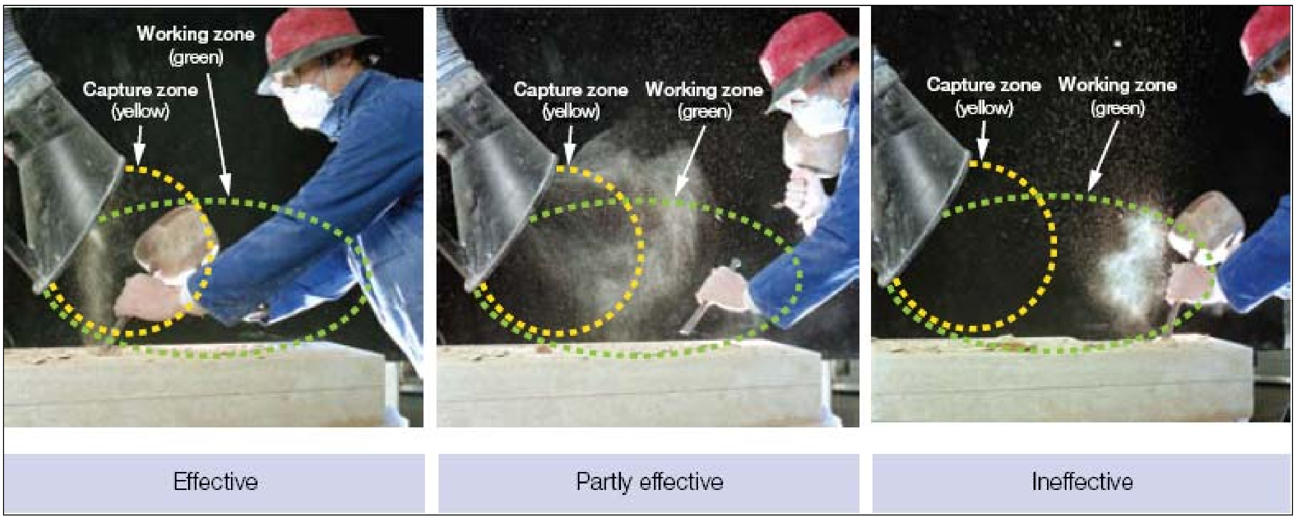
Industrial process	Nature of hazardous substance	Types of LEV
Welding	Welding fume: fine particulate with some natural buoyancy	Capture hood positioned close to the welding activity; or Tip extraction fitted to the end of the welding gun
Paint spraying	Mist and solvent vapours released in controlled direction with velocity	Walk in paint spray booth Down flow booth
Polishing	Metal and polishing dust released in controlled direction with high velocity	Receptor hood and enclosure around the polishing wheel
Shot blasting	Steel shot and metal dust from components released at high velocity in variable direction	Fully enclosed glove box type cabinet with airflow managed to compensate for compressed air input and shot recycling system
Hand held orbital Sander	Wood dust released in variable directions	Extraction integrated into the sander disc
Paint curing Ovens	Hot air and curing vapours with strong thermal buoyancy	Extract/vent from top of oven combined with a receptor hood over the doorway
Laboratory analysis	Acid and solvent vapours released with low velocity and little direction	Partial enclosure and extraction within a fume cupboard

Performance of Moveable LEV Capture Hoods, Tim added, was critically affected by their distance from the source of contamination, because the capture velocity falls to

10% at one diameter away from the face of the hood! This results in a "capture Bubble" around the hood face where effective capture takes place.



The effect of this can be seen from the following: -



The photographs (Secretary's Note: HSE source to illustrate Tim's point) above were taken with the aid of a Tyndall Beam Lamp, which shows up the respirable dust that cannot be seen with the naked eye. Under normal working conditions, the operative would not see the most harmful type of fume and would be very unlikely, therefore, to adjust the hood properly so that he was adequately protected. In such cases, comprehensive training is essential.

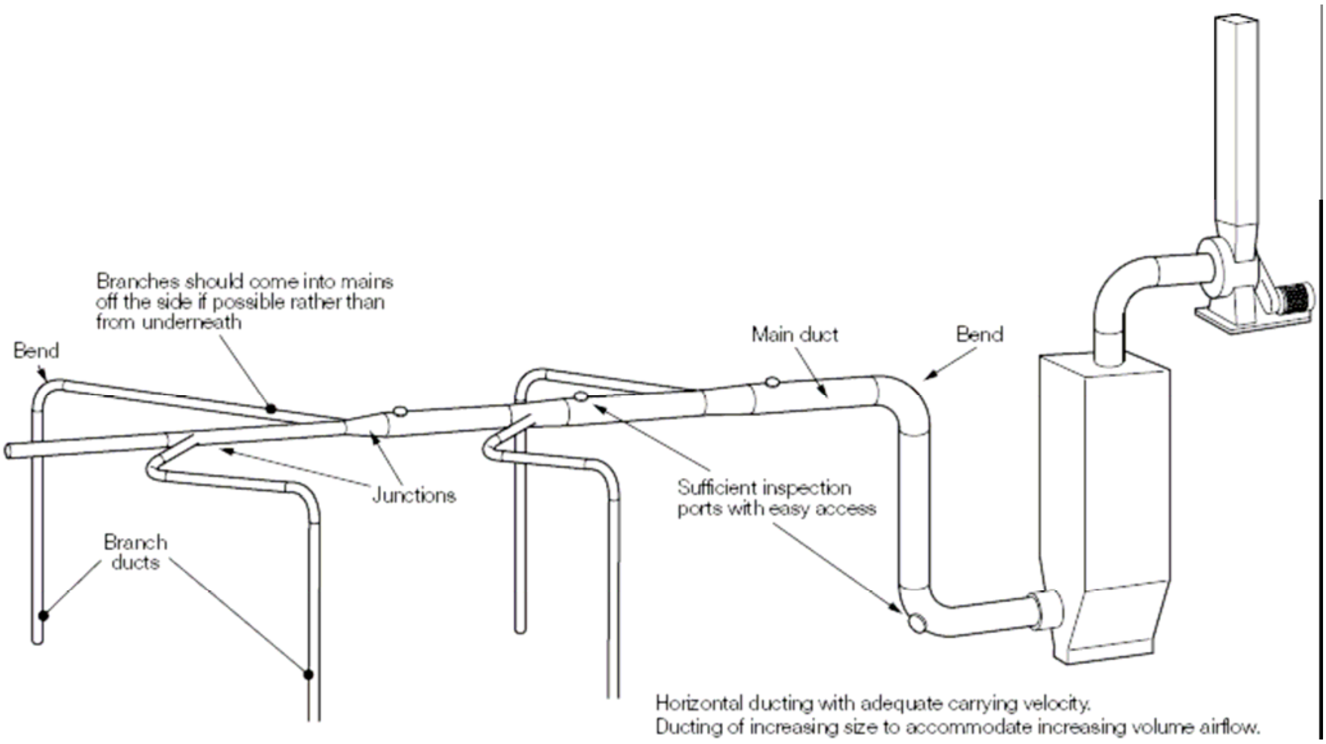
Soldering without and with a Tyndall lamp

Tim then went on to deal with the next important element of the system – Ductwork! The golden rules here are: -

- Velocity is important (See table below)

- Ducts should be sufficiently strong
- They should be well supported and capable of withstanding normal wear and tear
- The number of changes of directions should be kept to a minimum
- Bends should be made smoothly
- Access to ducting may be required for inspection and maintenance

Type of contaminant	Duct velocity (m sec-1)
Gases (non-condensing)	No minimum limit
Vapours, smoke, fume	10
Light/medium density dust (e.g. sawdust, plastic dust)	15
Average industrial dusts (e.g. grinding dust, wood shavings, asbestos, silica)	20
Heavy dusts, (e.g. lead, metal turnings and dusts which are damp or that tend to agglomerate)	25



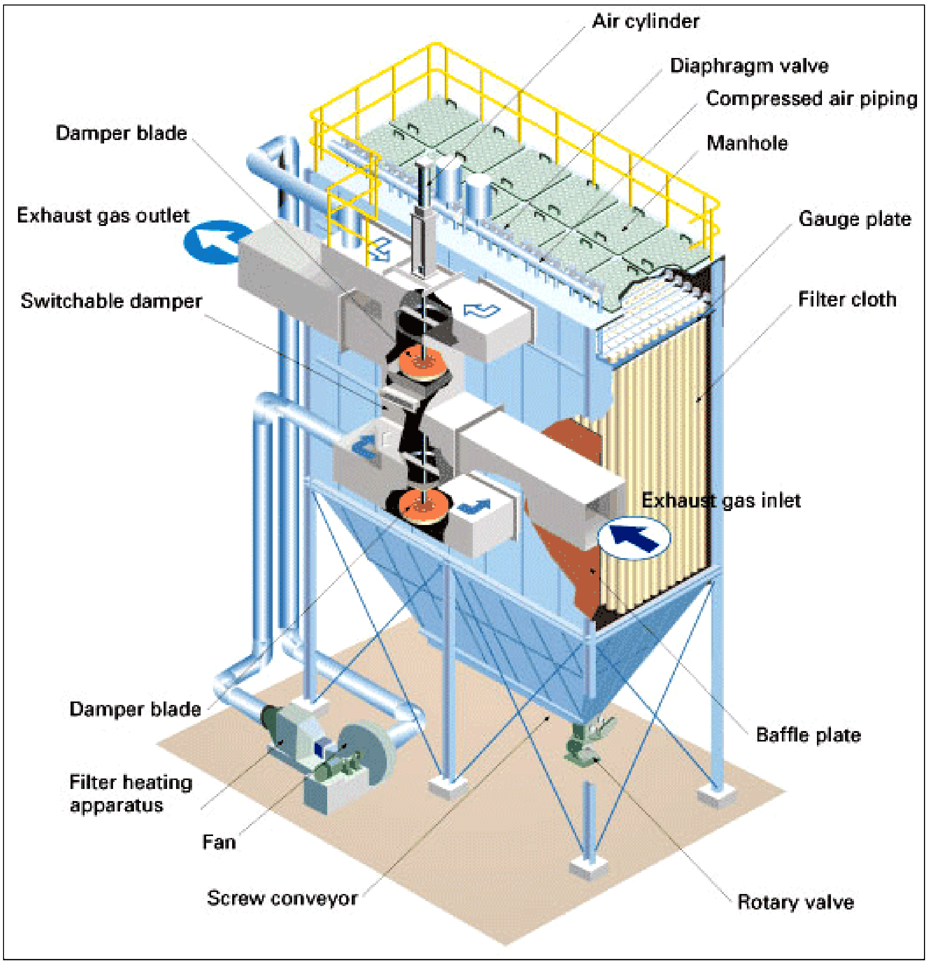
Typical Multi-branch System (HSE Source)

Tim emphasised that hoses were not a good choice in fixed installations to individual machines and commented about the many examples where they were sharply bent and damaged. He added that in most cases the velocity was not as great as in a domestic vacuum cleaner and that it was essential to know the size and nature of any particulates being extracted. In a large woodworking machine shop system, for instance large particulates would be separated out by a cyclone filter, before the finer particles would be deposited into a bag filter.

The transportation the particles is also governed by the choice of fan type. The one on the left is a Centrifugal Fan, which works well against high pressures in the multi-branch system. This type is also suitable for flammable contaminants, as the motor can be mounted outside of the exhaust flow.

In systems such as a paint spray booth, an axial fan (see right) would be used, where the volumes are high but the pressure is low. Both are just as noisy!

Tim then dealt with the next important part of many LEV systems, the filters and collection devices, when he asked "Why are they necessary?" The need, he explained, type and specification depends on factors related to the contaminant, the process and environmental considerations. The large filtration unit, shown on the left, is a very sophisticated design, capable of dealing with large volumes of contaminant, a range of ambient temperatures and includes provision for appropriate cleaning /maintenance procedures. It would normally be located outside a building to reduce noise within the working area and to facilitate access for maintenance.



On the subject of maintenance, Tim said that it was vital to comply with the manufacturer's manual, particularly with respect to frequency of checks against operational specifications and logs of inspections. Too often on older filters, he observed, manuals and logs were lost, in which case, it was necessary to hire a competent person to prepare a replacement. Checks and maintenance cover four types of parts: -

- Moving parts that wear e.g. fan bearings, filter shakers.
- Hoods, ductwork and seals that can get damaged.
- Parts that deteriorate with use e.g. filters, flexible
- Items that need regular attention e.g. filter bins, sludge collectors.

Some of these parts, Tim added, might also need to be maintained under Permits-to-Work in order to prevent inadvertent operation during this work! Because contaminants may be hazardous, COSHH assessments could also be a crucial pre-requisite for cleaning and maintenance operations and everyone must know who is responsible for what checks! Most LEV needs a statutory check at least every 14 months and this must be done by a competent person, tested against minimum legal standards.

Tim went on to say that the report recommendations should be implemented and examination records should be kept for at least five years. A long list of actions arising from these tests shows that an employer's maintenance is not thorough enough.

As with all powered systems that are safety-related, it is vital to ask what training does the operator need: -

- Training should cover how the LEV system works.
- Get the best performance out of the system.
- How to check that it is working AND
- What to do if something goes wrong

As with all safety training, it is important to keep records and, if the work process or LEV changes, then staff may need re-training.

Tim now addressed the crucial issue of buying new LEV systems. It is vital, he said, to use a reputable supplier with specific experience of the controls you need. You must, he warned, ask the suppliers how they will prove that their system will control exposure adequately. LEV is rarely straightforward, he went on, and mistakes are costly – afterwards! To avoid these pitfalls, he advised, you must specify your LEV.

- You must describe the process, the contaminant, its hazards and the sources to be controlled and how stringent the control needs to be.
- You must require indicators to be fitted to show that the system is working properly.
- You must require the LEV to be easy to use, check, maintain and clean.
- You must specify that the supplier provides training in how to use, check and maintain the LEV system.
- You must require the supplier to provide a user manual that describes and explains the LEV system, how to use, check maintain and test it, along with performance benchmarks and schedules for replacing parts.
- You must require the supplier to provide a logbook for the system to record the results of checks and Maintenance

See: -

HSE leaflet INDG408, Clear the air

HSG258 Controlling airborne contaminants at work: A guide to local exhaust ventilation

INDG409 Time to clear the air A workers' pocket guide to LEV (Pocket Card)

(All freely downloadable from www.hse.gov.uk)

Tim concluded showing some slides of case studies and by thanking Dr.Adrian Hirst for his permission to use his diagrams and illustrations in the presentation. Tim Prestage was on hand, afterwards to demonstrate a range of instruments used by them in their consultancy.