Guidance

Local Exhaust Ventilation

Control of Substances Hazardous to Health Regulations 2002 (COSHH)

Dangerous Substances and Explosive Atmosphere Regulations (DSEAR)

LEV processes

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CONTENTS

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PURPOSE OF IN-SERVICE THOROUGH EXAMINATION

Member Companies that undertake thorough examinations and tests of Local Exhaust Ventilation (LEV) require clear and definitive guidance with respect to the procedures that should be adopted. The purpose is to ensure that such control measures are maintained in an efficient state, in efficient working order, in good repair and in a clean condition, so that the control measure is effective in adequately controlling the hazardous substance in accordance with Regulation 7 of COSHH. Unlike other thorough examinations to ensure the continued safe use of equipment, the purpose of a thorough examination of LEV equipment is to ensure that it provides the effective and adequate protection from airborne hazardous substances to protect workers. In some cases, this may require air sampling to confirm the workplace exposure assessment. This can be provided by the inspection body, if they have the necessary equipment and competence to do so, or it can be provided by an external organisation as a supplementary test.

GUIDANCE

The aim of this Guidance is to provide member companies with the appropriate information to ensure that the requirements of the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH) Regulation 9, the Control of Lead at Work Regulations 2002 (CLAW) Regulation 8, and the Control of Asbestos Regulations 2006 (CAR) Regulation 13 are taken fully into account when undertaking LEV thorough examinations and tests. In addition, the Guidance will help to achieve a consistency of approach by member companies when undertaking this activity, covering a variety of processes by ‘typical extraction type’.

FOREWORD

SAFed has prepared this guidance based on the collective experience of its members. The Guidance is for the use of Engineer Surveyors (ES) and it assumes a level of competence in the examination and testing of LEV to cover the legal requirements to examine such equipment. It should not be regarded as an authoritative interpretation of the law. However, if the guidance it provides is followed and used in conjunction with the current Regulations, it will normally be regarded as sufficient to comply with health and safety law in relation to the thorough examination and testing of LEV.

COMPETENCE REQUIREMENTS

There is a legal requirement for all inspection bodies carrying out the engineering inspections and thorough examinations of plant and machinery to be competent to do so. In all cases, both the inspection body and the individual engineer surveyor (competent person) must have the necessary competence, equipment and resources. For Local Exhaust Ventilation (LEV) systems, this requires a general engineering or occupational health qualification, but with a general knowledge of the other (engineering or occupational health) discipline, together with a knowledge the legal requirements under the relevant legislation. In particular, it is essential to have a knowledge of the variety of hazardous substances found in the workplace, their specific risks to health and safety, an understanding of workplace exposure limits, together with the necessary knowledge, training and experience to assess LEV systems and make a judgement as to whether the system is effectively controlling the hazardous substance.

A guide to competence is provided in SAFed Standard 01, Recruitment, Training and Competency of Engineer Surveyors, however, a more formal demonstration of competence is provided by UKAS accreditation to ISO/IEC 17020, the international standard for the competence of Inspection Bodies. Inspection bodies who have such accreditation for the scope of LEV Inspections have demonstrated their competence to do so. Inspection bodies, who do not have the required competence for this scope and discipline, should not undertake such statutory thorough examinations.

1. LEV & PROCESSES

In order to undertake a LEV examination and test in a safe and competent manner, the ES needs to be aware of key information to understand the individual LEV system, the particular work process concerned, the workplace environment and, in particular, the potential for explosive atmospheres. Such key information would include details of the component parts of the LEV under examination and test, the process (i.e. the source of the hazardous substance), the hazardous substance(s) and the existing workplace exposure.

2. LEV COMPONENTS

The components considered in this Guidance include; air cleaners; air movers; and ducting, hoods and enclosures.

2.1. Air cleaners

Air cleaners covered by this Guidance are shown in **Appendix A.**

A.1 Fabric filter,

A.2 Cartridge filter,

A.3 Cyclone,

A.4 Wet back booth,

A.5 Electrostatic precipitator,

A.6 Wet collector,

A.7 Sintered.

Other types of filter media are available, and an ES might encounter these in similar configurations to those shown above and would include: Fabric bags; Scrubbing units; Paper/mesh. In addition, consideration is to be given to space arrestors and particle chambers. The ES should also consider aspects of explosion relief, details of which are given in A.8.

2.2. Air movers

Air movers covered by this Guidance are shown in **Appendix B.**

B.1 Centrifugal fan,

B.2 Axial fan,

B.3 Bifurcated fan,

B.4 Venturi,

B.4 Turbo exhauster,

B.5 General considerations,

B.6 Multiple fan configurations.

2.3. Ducting, hoods and enclosures

Ducting, hoods and enclosures covered by this Guidance are shown in **Appendix C.**

C.1 Ducting,

C.2 Hoods,

C.3 Enclosures.

3. SUPPLEMENTARY PROCEDURES TO ESTABLISH/CONFIRM WORKPLACE EXPOSURE

Supplementary procedures covered by this Guidance are shown in **Appendix D.**

D.1 Air sampling,

D.2 Clearance time and leakage test.

D.3 Filter efficiency

4. PROCESS GUIDE FORMAT

Each process guide will cover some or all of the following for consideration:

- Initial Requirements to be provided by the employer to the engineer surveyor carrying out the thorough examination:
  - Work process and list of airborne contaminants
  - COSHH Hazard data sheets
  - Air sampling records or justification for not carrying out air sampling.
  - Initial commissioning report of LEV System
  - Previous thorough examination report
  - Maintenance records
  - Daily check records
- Periodicity,
- Substances,
- Potential hazards,
- Test points,
- Test methodology,
- Air sampling (to be carried out by engineer surveyor)
- Typical problems.

5. PROCESSES

The processes under examination and test covered by this Guidance, listed at 5.1 to 5.7, are shown in **Appendix E.**

5.1. Fume extraction systems

E.1.1 Vehicle exhaust,

E.1.2 Welding.

5.2. Dust extraction systems

E.2.1 Woodworking,

E.2.1 Stone masonry

E.2.1 Metal abrading.

E.2.1 Other e.g. Bakery/transport and supply

5.3. Shot blast systems

E.3.1 Room type,

E.3.2 Glove type,

E.3.3 Machine type.

5.4. Fume cupboards

E.4.1 Multiple system (negative pressure ducting),

E.4.2 Single system (positive pressure ducting),

E.4.3 Re-circulatory system.

5.5. Surface coatings

E.5.1 Enclosed side draught spray booth,

E.5.2 Robotised/automated spray booth,

E.5.3 Automotive down draught spray booth,

E.5.4 Hybrid spray booth,

E.5.5 Open fronted side draught booth.

5.6. Dipping

E.6.1 Vapour degreasing,

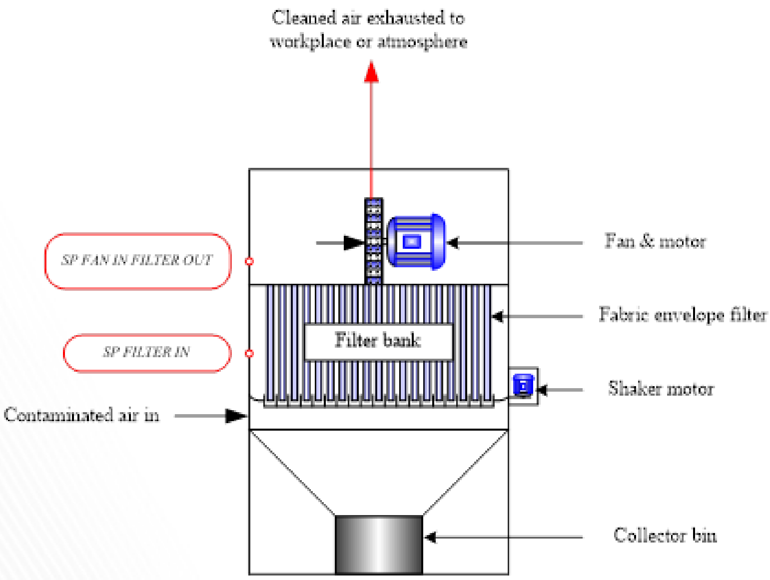
E.6.2 Pickling, electroplating, cold cleaning, etc.

5.7. Dilution ventilation

E.7.1 Battery charging.

APPENDIX A — AIR CLEANERS

A.1 — Fabric filter



Principle of Operation

Contaminated air is drawn into the lower chamber and forced to turn sharply upwards and through a bank of envelope shaped fabric filters. This initial tortuous path causes larger particles to fall straight into the waste bin; the smaller particles being trapped as the air is drawn through the filter fabric.

The filter envelopes are fixed at one end and attached to a rack at the other. This rack is connected to a shaker motor which, once the fan has been switched off and allowed to slow down, cuts in and gives the bags a vigorous shaking causing the trapped particulate to fall down into the collector bin.

Efficiencies of up to 99.9% can be achieved, depending on the size of the particulate. The filter tends to become more efficient as the fabric gets choked and it becomes harder for small particles to pass through.

Some units are fitted with a second stage panel filter after the fan / motor assembly for better performance.

Fabric envelope filters are best used for processes producing dry particulate.

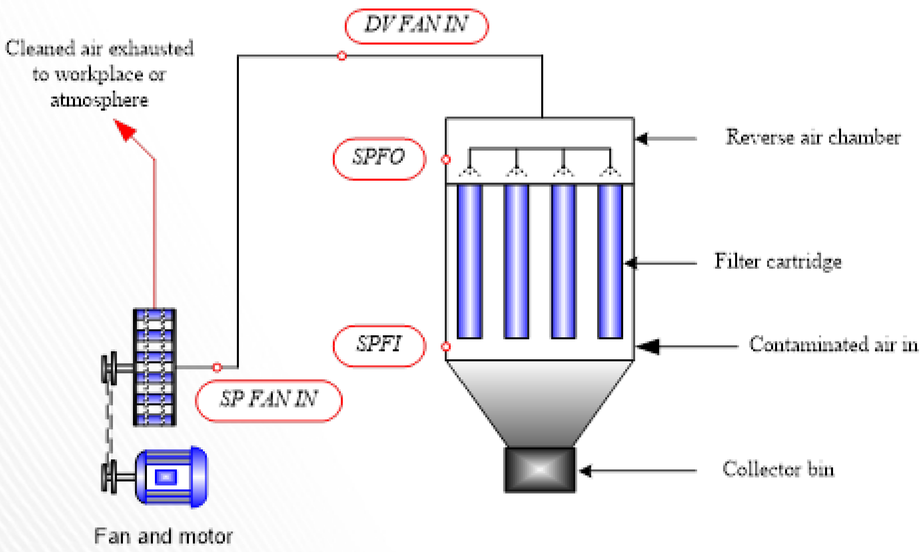
Examination Hazards:

- Inhalation of particulate,
- Access to inspection doors / covers and exhaust grille,
- Weight of removable inspection covers.

Potential Performance Issues:

- Seal integrity,
- Defective shaker mechanism linkage, bags not connected to shaker rack, incorrect shaker delay; either too long or too short,
- Envelopes punctured or torn,
- Air mover — see separate section.

A.2 — Cartridge filter



Principle of Operation

Contaminated air is drawn into the lower chamber and forced to turn sharply upwards through a bank of cartridge filters. This initial tortuous path causes larger particles to fall straight into the collector bin; the smaller particles being trapped as the air is drawn through the filter medium.

The cartridges may be mounted vertically or horizontally.

The usual method of cleaning the filters is by a reverse air jet; a pulse of high-pressure air is injected into the cartridge in the opposite direction to the normal air flow causing the trapped particulate to be blown out and fall into the collector bin.

Efficiencies of up to 99.9% can be achieved, depending on the size of the particulate. The filter tends to become more efficient as the filter medium gets choked and it becomes harder for small particles to pass through.

Cartridge filters are best used for processes producing dry particulate.

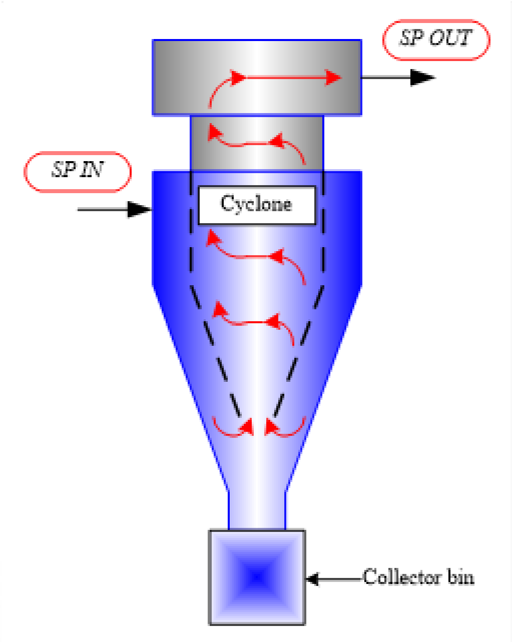
Examination Hazards:

- Inhalation of particulate,
- Access to inspection doors / covers and exhaust grille,
- Weight of removable inspection covers.

Potential Performance Issues:

- Seal integrity,
- Defective reverse air system, solenoids defective, control air lines crimped or leaking, air pressure too low, incorrect pulse frequency,
- Cartridges punctured or torn,
- Air mover — see separate section.

A.3 — Cyclone



Principle of Operation:

Contaminated air is introduced tangentially into the cyclone causing it to rotate. As the air rotates it is drawn down into a cone, the reducing diameter of which causes it to rotate even faster, imparting a centrifugal force on the airborne particulate. This force throws the particulate against the wall of the cone where it falls into the collector bin. The cleaned air is then allowed to pass up a central pipe and out of the filter.

Efficiencies of between 40 – 70% can be achieved, depending on the size of the particulate.

Cyclones are best used for large particulate (>25 microns) produced by machining, grinding and woodworking etc or as a pre-filter for higher efficiency systems.

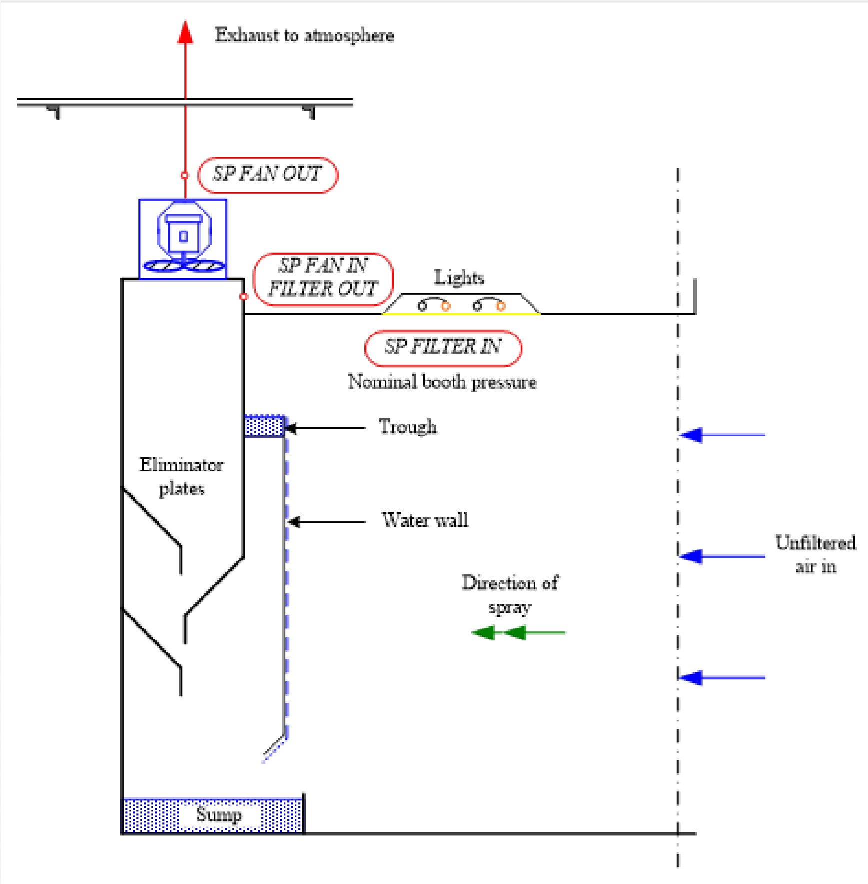
Examination Hazards:

- Possible access problems.

Potential Performance Issues:

- Seal integrity,
- Erosion of cyclone wall by particulate,
- External corrosion.

A.4 — Wet back booth



Principle of Operation:

Water is allowed to flow down the back wall of the booth and fall as a curtain into the sump. Air is drawn from the spraying area, through the curtain where it causes the water to break into fine droplets and over a series of baffle and eliminator plates that remove any excess water before being exhausted to atmosphere. Overspray is carried by the air flow, through the curtain where it is caught by the water droplets and carried down to the sump. Chemicals in the water cause the overspray to coagulate and either float on the surface of the water as a scum or sink to the bottom of the sump where it can be collected and disposed of.

Examination Hazards:

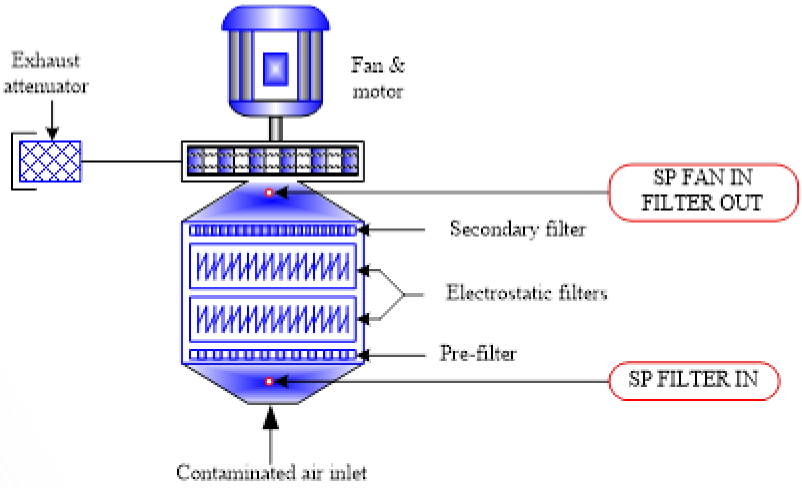
- Exposure to sprayed substances, cleaning chemicals and legionella disease.

Potential Performance Issues:

- Incorrect water level,
- Poor water treatment regime,

- Build-up of overspray on surfaces,
- Clutter in spraying area,
- Draughts from adjacent booths, open doors, windows etc,
- Air mover — see separate section.

A.5 — Electrostatic precipitator



Principle of operation

The principle of the electrostatic precipitator is to give dust or fume particles a high voltage electrical charge, which will attract them onto collecting surfaces with an opposite charge. The arrangement often consists of wires suspended either in vertical tubes or between charged plates. Efficiencies of 92-98% can be achieved for 5 micron size particles but some materials do not charge easily and will tend to pass through the device.

Large Particles are trapped by a mechanical pre-filter. Small particles continue through the unit to a collecting section where they are attracted to a series of earthed plates. The pollutant particles are held in this section until being washed away during cleaning.

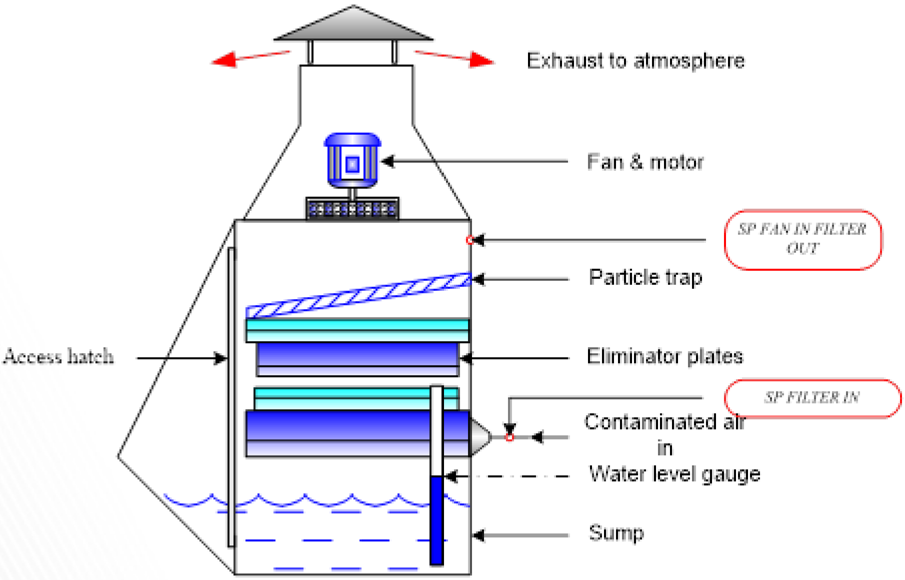
Examination hazards

- Electric shock: Discharge unit before opening.

Potential performance issues

- Broken wires,
- Congested pre-filter,
- Cleanliness of collector plates,
- Defective indicators,
- Seal integrity,
- Air mover — see separate section.

A.6 — Wet Collector



Principle of operation

In wet collectors, airflow through the collector induces a spray curtain which absorbs the contaminant dust. Spray eliminators separate the cleaned air from the dust-containing water droplets, and the contaminant settles out as sediment and scum within the collector sump. Collection efficiencies up to 93% for 5- um particles are possible. This type of unit is appropriate for substances which in the dry dust form could be flammable or potentially explosive.

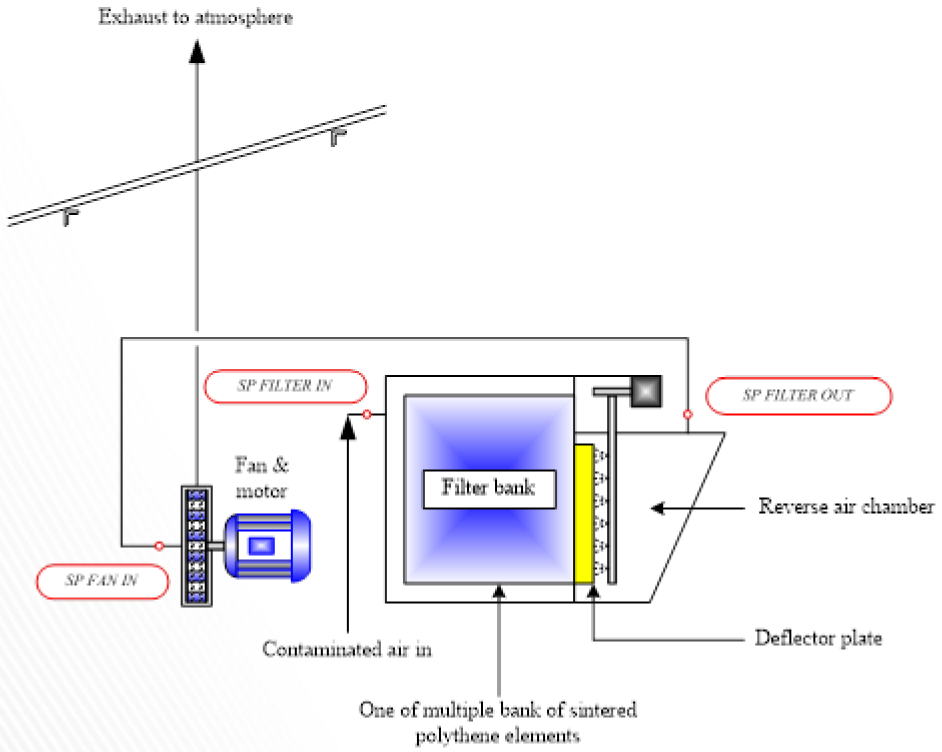
Examination hazards

- Entrapment — Isolate electrical supply before opening and removing access hatch.

Potential performance issues

- Holed and damaged enclosure and elements from corrosion,
- Congested particle trap,
- Cleanliness of eliminator plates,
- Low water level,
- Seal integrity,
- Air mover — see separate section.

A.7 — Sintered



Principle of Operation

Contaminated air is drawn into the filter chamber and through a bank of pocket shaped sintered polythene elements manufactured from a carefully controlled blend of granulated polyethylene polymers. These elements provide up to three times more surface filtration area than conventional fabric filters and they are highly resistant to acids, alkalis and other chemicals.

The elements are fixed at one end; the method of cleaning the filters is by a reverse air jet, a pulse of high pressure air is injected across a deflector plate and into the element pockets in the opposite direction to the normal air flow causing the trapped contaminant to be blown out. They are designed to cope with the high dust concentrations and variety of products encountered in the pneumatic conveying of raw materials and particulate products.

Examination hazards

- Substance contamination. This type of air cleaner is predominantly used with high concentrations of hazardous substances, so advice should be sought regarding suitable personal and respiratory protection equipment when opening the filter access hatch.

Potential performance issues

- Congested filters (be aware however due to the high filtration efficiency the pressure differential will be high),

- Seal integrity,
- Defective reverse air system, solenoids defective, control air lines crimped or leaking, air pressure too low, incorrect pulse frequency,
- Air mover — see separate section.

A.8 – Explosion Relief and control

Many materials used on a daily basis produce dust that is flammable and in the form of a cloud can explode if ignited. Such examples are:

Sugar, Flour, Grain, Wood, Leather, Titanium and Aluminium.

If the solid form is converted to a fine powder, suspended in air as a dust and ignited, the cloud may burn very rapidly and could result in an explosion. This creates a rapid release of heat and gaseous products and in the case of a contained dust cloud can cause the pressure to rise to levels that the plant was not designed to withstand (ie an explosion).

In accordance with DSEAR 2002 Regulation 6(4)(d) one method on reducing the explosive atmosphere is the provision of adequate ventilation, which could be provided by LEV systems. However, the dangers of this are that dust could accumulate in a confined space (eg. the LEV ducting) before being exhausted to a safe environment. It is essential, therefore, that no sources of ignition exist (DSEAR Regulation (4)(f) and that the waste is exhausted safely in accordance with DSEAR Regulation 6(4)(c) and (e).

Where LEV is involved with hazardous substances that have the potential to present an 'explosive atmosphere', the Duty Holder should conduct a suitable and sufficient Risk Assessment in accordance with the requirements of Regulation 5 of DSEAR (section entitled 'Prevention' below refers).

Preventing, Relieving and Supressing Explosions.

Extraction systems handling combustible materials, present a risk of ignition, propagating an explosion. Hot sparks, an electrical fault, static electricity or even moisture for volatile metals can be the source of ignition. An explosion occurs when; the concentration of dust is contained within a collector and sufficiently combined with oxygen and a source of ignition. During an explosion the pressure within the collector increases and must be relieved to prevent catastrophic damage.

Preventing an explosion protects the machinery, the employee and the building structure and therefore the duty holder from costs. Where prevention cannot be relied upon alone, then supplementary control measures should be employed, such as; explosion relief, venting or suppression.

Prevention

Simple measures and or devices can assist in preventing an explosion.

Measures may include but are not limited to; completing a DSEAR Risk Assessment and implementing the findings that may include; zone controls, use of ATEX rated motors and electrical components, fixtures and fittings, in conjunction with well managed and controlled operating procedures. Avoiding the use of materials with explosive properties should be considered but may not be avoided.

Devices fitted to the extraction system may include but are not limited to; continuity bonding of conductive components such as metal or flexible ducting with spiral wound wire support, drop out boxes in the ducting and or inline spark arrestors.

- Drop out boxes are sections of ducting that are larger than the inlet and outlet ducting and may contain a baffle plate to prevent straight line flow. The volume change from the duct to the box causes the velocity to drop and the heavier particles fall out before the volume changes back at the exit point where the velocity regains its original magnitude. This helps prevent the carryover of particles that may cause an ignition.

- Spark arrestors are inline devices that cause the air to vortex, similar to a cyclone; this throws the suspended particles to the wall of the arrestor before exiting to a bin. Spark arrestors are positioned a safe distance before the filter.

Risk management and good housekeeping will ensure explosion risks and consequences are minimised. Risk control aims to eliminate the process and or quantity of materials used. Good Housekeeping will reduce dust levels within the workplace.

Types of Explosion Control

1. Relief venting
2. Suppression
3. Inerting

Relief Venting

Cyclones - bursting panel

Filter units – Bursting panel or disc either aluminium or neoprene, hinged or tethered flap.

Flameless Venting – a combination of layers of micro mesh.

Silos – non powered or powered filters fitted with bursting panels.

Relief panels provide a simple and cost-effective solution to preventing pressure build-up within the extraction unit.

Note; Older extraction units were fitted with a manmade material that made up the busting panel/disc that may have contained asbestos. Clients should have identified this in their asbestos survey and register. If in doubt as to the material in use, seek guidance from the client on whether it is in their register.

Explosion Control

Filter unit – Flameless Venting, Suppression

Flameless venting provides a solution that is likely to provide greater compliance with DSEAR.

Flameless venting is achieved by controlling the heat element within the explosion. When the primary explosion occurs, burnt and unburnt dust passes beyond the bursting panel and enters the flame arrestor. Flame propagation is controlled within the flame arrestor by energy (heat) propagation. The retention of the fuel within the flame arrestor reduces the burning dust below its ignition temperature. The dust is largely retained within the flame arrestor and gases are safely released to the atmosphere.

Advantages of Flameless venting are; greatly reduced pressure fields local to the extractor, elimination of flames being ejected, no secondary explosion risk.

Suppression Systems use fast monitoring sensors to determine an unsafe condition is developing and the electronic control system will stop machinery, close automated valves and release inert gas to starve the space of oxygen and thus prevent flame propagation.

Inerting

Inerting involves the addition of inert substances to either the atmosphere or dust to prevent an explosion occurring in a dust cloud. Inerting can work as explosion prevention as it interferes with flame propagation or acts as a heat sink. By adding an inerting component to the dust, the cloud is diluted, and this reduces the explosive properties. Such dusts include; calcium sulphate, limestone, sodium bicarbonate and common salt.

Inert gases can also be introduced to reduce the overall oxygen content in the atmosphere. It can either be partial or complete substitution. Inserting is only suited to fully enclosed plant. Typical situations where inerting may be used include; Process equipment such as enclosed reactors, mixers, pulverisers, mills, cyclones and dust collectors, storage units such as Silos and Hoppers, Conveyors and Elevators.

Inerting is recommended for more volatile dusts. Typical Inert gases are; Nitrogen, Carbon Dioxide, Argon and Helium.

Other Risk Factors

Even after controlling the explosion risk and providing explosion relief there may still be other risks to consider. By design the extraction system that includes an explosion relief panel will permit a release of energy and a fire ball to reduce the risk of the extractor being blown apart. A poorly cleaned workplace could result in settled dust on surfaces being dislodged and then ignited causing greater damage than the original blast. This ignition following the initial incident is known as a secondary explosion and may also create a chain of explosions. Housekeeping must be discussed with the client where a dust is not being removed from building services.

The orientation of the blast relief device should be such that it does not give rise to a risk of injury to persons in the workplace. Therefore, it is essential that the path of the blast relief does not;

- Cross walkways or
- Face onto building structural walls or

- Face onto other services that could be damaged or explode.

Positioning of units fitted with explosion relief (refer to illustrations below)

1. Primary and preferred position should be to place the unit fitted with explosion relief outside in free space with clear space to discharge any shock wave and flame.

2. Inside the building if it is not possible to place it outside, utilising ducting and place it as close to an exterior wall as possible to permit venting to outside atmosphere. The ducting should meet the following criteria;

- Cross-section equal to or up to 10% greater than the relief dimension
- Be designed with a maximum of one 90 degree bend
- Be designed with a maximum length of 3 metres
- Be manufactured with a ‘strong’ construction

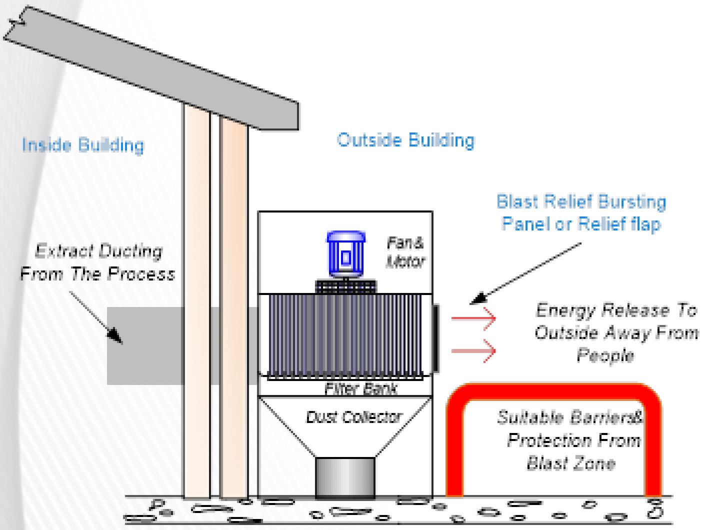
3. Inside with clear space to vent any shock wave and flame horizontally, it is suggested that a minimum of 5 metres is required.

4. Inside venting vertically due to lack of horizontal space with only one change in direction to discharge any shock wave and flame. No additional ducting to be added after first bend.

5. In every case the filter unit should be suitably secured to the floor.

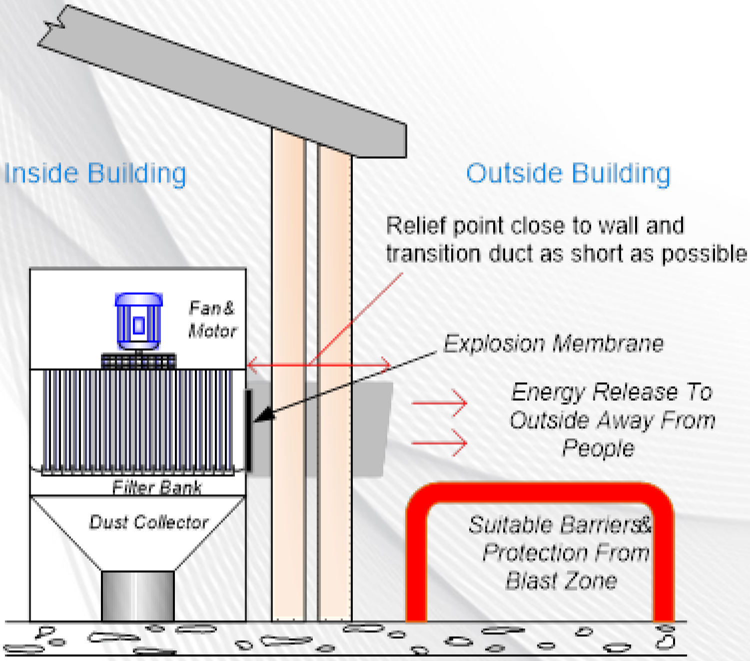
Solutions for siting Extractors with Explosion relief in order of Preference.

1. Relief Point Outside Building



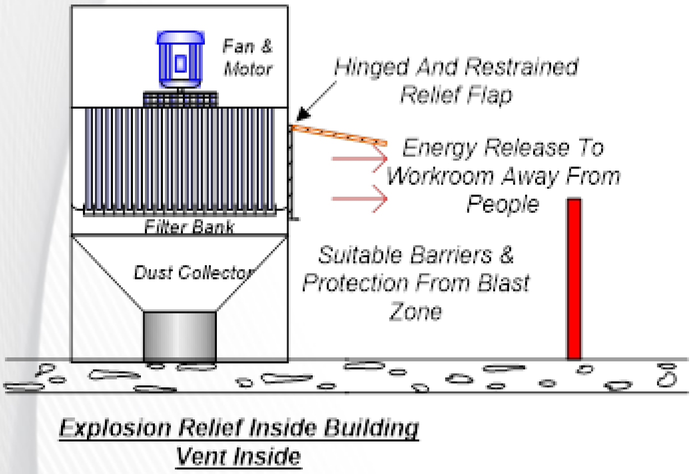
Explosion Relief Outside Building

2. Extractor Inside Relief Point Ducted to Outside

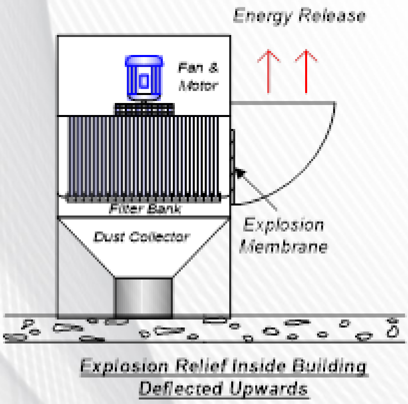


Explosion Relief Inside Building
Vent To Outside

3. Extractor internal vented internally horizontally



4. Extractor internal vented internally vertically



Ancillary Equipment

Rotary Valves on waste ports prevent free air entering the extractor and prolonging the fire or explosion and prevents the flame igniting dust outside the filter enclosure.

Back draught dampers mounted on the filter inlet ducting prevent flames passing back through the extract system to the process capture points.

Sprinkler heads piped into the extraction unit.

Key Examination Points

Look for indications that the risk is not properly controlled or that the explosion relief mechanism may be compromised.

- Is there an Explosive substance Ignition Risk?

- Is there an Ignition Risk?
- Has the extractor been provided with Explosion relief?
- Has extractor been positioned correctly with explosion relief vented adequately?
    - Short duct to outside
    - If sited outside does internal ducting have a fire damper fitted
    - Not up against or facing a wall
    - Not facing high usage pedestrian root walkways, alleyways
- Is extractor suitably secured to the floor?
- Has membrane been visually inspected and is it satisfactory?
    - Where a change in direction bend is fitted – visually examine internally to check for foreign objects
    - Check for tears in the membrane material
    - Check for splits in the busting panels
    - Check for mastic seal erosion on cyclone relief panels
- Is the blast relief flap securely hinged and retained (chains or tether wires ensuring the restraint allows for full opening)?
- Is there a significant dust levels on surrounding surfaces that could be ignited as a secondary explosion?
- Has continuity bonding been fitted?

APPENDIX B — AIR MOVERS

B.1 Fans

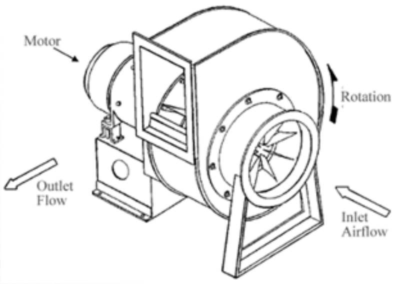
There are two main types of fan: centrifugal and axial.

B.1.1 Centrifugal

Centrifugal - these are the standard type fans used in most LEV applications. There are three types:

- Radial: good for low efficiencies,
- Forward blade: good for high flow resistances,
- Backward blade: most efficient, use at high speed,

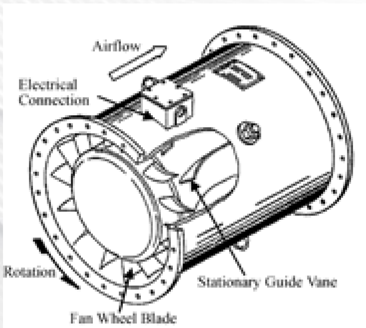
If run in reverse direction, these fans will supply air in the correct direction but at approximately 66% efficiency. Fans are either direct or belt driven.



Centrifugal fan type operation

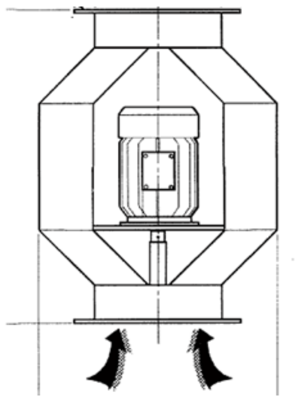
B.1.2 Axial

Axial inline fans are good for low resistances and sometimes operate in pairs. Fans usually direct drive but can be belt driven with motor being external to air stream.



Axial fan type operation

Note: A bifurcated axial fan (motor outside air stream) will often be used to extract air containing flammable air concentrations.

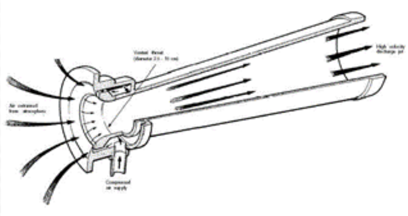


Bifurcated axial fan type operation

B.2 Other types

B.2.1 Venturi

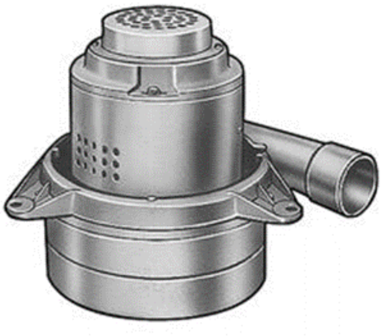
The venturi (compressed air driven) is considered good for small spaces and where no electricity supply is available.



Venturi — Compressed air driven type operation

B.2.2 Turbo exhauster

Turbo exhausters are considered good for very high velocity applications where high suction is required.



Turbo exhauster

B.2 General considerations

B.3.1 Selection considerations:

- Area or environment where the air mover is used,
- Type of contaminant being transported,
- Flammability of contaminant,
- Position of air mover i.e. fore or after air cleaner (filter),
- Provision/arrangements for air make-up.

B.3.2 Performance considerations:

- Static pressure at inlet to fan (Pa),
- Volume of air handled (m3/s),
- Speed (rpm),
- Direction of rotation (from drive end).

B.3.3 Potential performance issues:

- Incorrect direction of rotation,
- Slippage of drive belts (incorrect speed),
- Damaged case from either mechanical or environmental,
- Poor duct joints/connections causing leakage,
- Fan incorrect type for environmental conditions,
- Noisy drive bearings,
- Missing guards causing entanglement hazard,
- Inadequate air make-up arrangements.

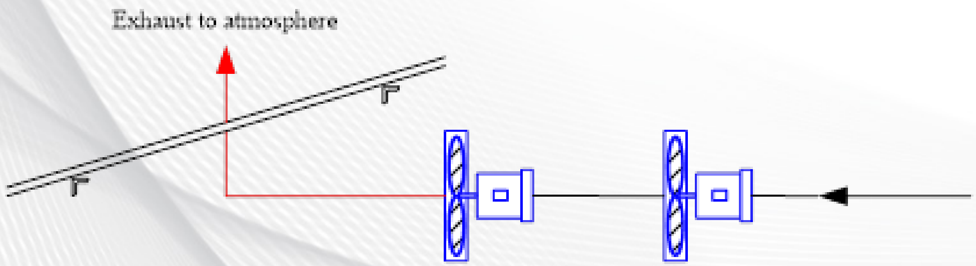
B.4 Multiple fan configurations

B.4.1 Fans in series

The use of fans in series must be considered against their advantages and disadvantage:

Advantages — Higher static pressure development for a given volume flow.

Disadvantages — During normal operating conditions, user may not be aware if one fan is not being driven by its motor resulting in reduced static pressure.



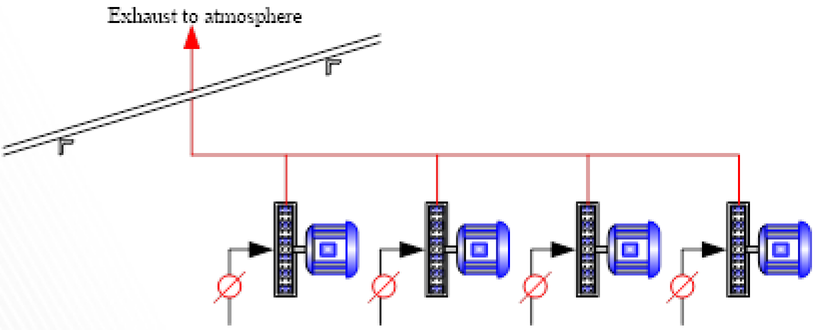
Fans in series

B.4.2 Fans in parallel

The use of fans in parallel must be considered against their advantages and disadvantage:

Advantages — Higher volume flow development for a given static pressure. Can be used in main or standby duty with auto change over.

Disadvantages — During normal operating conditions, user may not be aware if one fan is not being driven by its motor resulting in reduced volume flow.



Fans sharing common manifold exhaust stack

APPENDIX C — DUCTING, HOODS AND ENCLOSURES

C.1. Ducting

The purpose of ducting is to provide a safe route for the transport of the hazardous substance from the point of capture to the air cleaner, if fitted, and then to transport the exhaust to a safe point of discharge.

C.1.1. Construction:

Ducting is usually rigid and made of galvanized sheet steel although aluminium or plastic may be used for processes where the hazardous substance is corrosive rather than erosive e.g. fumes rather than dust. Flexible ducting may be used where it is necessary to frequently move the captor hood e.g. welding, or where the hood is attached to moving machinery.

C.1.2. Design:

Ideally, the extract ductwork layout should be as simple and as short as possible. It should be well supported along its length and designed so that the air (transport) velocity within it is sufficient to stop any particles settling out and blocking the duct. Bends, junctions and changes in section should be made smoothly to cut down on flow resistance; bends should have a radius of at least 1 1/2 duct diameters and junctions should have a small joining angle and enter the main duct at the side rather than the bottom. Runs of flexible ducting should be as short as possible, again to avoid high flow resistance and also because it tends to wear very quickly. Depending on the size and purpose of the system inspection covers may need to be provided in the ducting to allow internal inspection and cleaning. If the system has more than one extract point it may be necessary to provide flow dampers to balance the system and ensure each point extracts efficiently.

Depending on the process and position of any air cleaner, it may be necessary or desirable to duct the exhaust air away for discharge to atmosphere. To prevent the exhaust from affecting passers-by or avoid it re-entering the building it may be necessary to extend the ducting to above the roof level. Any external ducting should be capable of withstanding the rigours of the weather.

C.1.3. Examination and Testing:

Although testing the extract system obviously requires it to be running, examination of ducting is best carried out with the system shut down. Some high-level working may be necessary to inspect duct supports and gain access to inspection covers and test points.

The ducting should be inspected for holes and other damage caused either by the hazardous substance to the inside of the duct, corrosion or external causes such as passing vehicles or bins, pallets etc being stacked against it.

If inspection doors are provided the interior of the duct should be checked to make sure there is no build-up of dust etc. within; if they are not fitted, the sound produced by tapping the duct at various points around its circumference and along its length may indicate an accumulation of dust.

Any flow control dampers should be checked for evidence of tampering and set to their original positions prior to taking any readings.

The seal of joints, seams and inspection doors, if fitted, should be tested for leakage using a smoke tube. Depending on the standard of housekeeping, leaks may also be highlighted by the amount of dust and dirt near the leak.

Static pressure test points should be provided immediately behind any hood or capture point, ideally test points should not be positioned in flexible ducting as this may cause damage to the ducting and give unreliable readings.

Each long run of ducting should be provided with a test point to enable a velocity pressure or air speed reading to be taken to check the transport velocity in the duct. The test point should be positioned at least 6 and preferably 10 duct diameters from any bend, branch or change in section.

C.2. Hoods

There are two main types — Capturing hoods and receiving hoods.

For both, the process to be controlled takes place outside of the hood.

C.2.1. Construction:

Hoods are usually rigid and may be made from metallic, plastic or wooden materials.

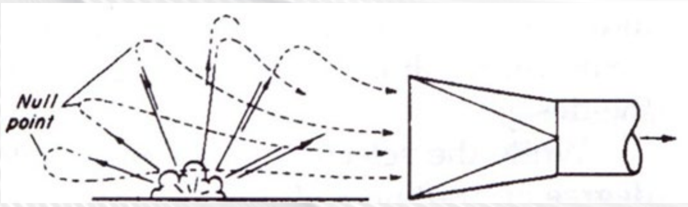
The correct choice of material will depend on the application, position and hazardous substance(s) being controlled.

C.2.2. Design:

Capturing hoods require the LEV generated airflow to “reach out” and “capture” the contaminant-laden air. They can vary considerably in size and shape, from 5 mm diameter nozzles to rectangular hoods several m2 in area. They need to be large enough to cover the movement of the source, or be easily moveable, or it should be possible to easily move the source so that it is always within the “capture zone”.

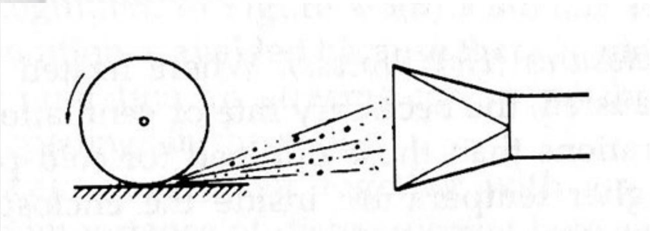
Adequate airflow velocity within the capture zone is essential to ensure that sources with a strong directional airflow or external draughts do not adversely affect control.

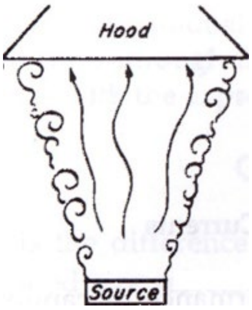
The volume flow rate of the hood must exceed the emission / volume flow rate of the source.



Receiving hoods are appropriate for processes emitting hazardous substances which have an inherent energy, kinetic or thermal. The hood must be placed in the path of air stream generated by the process. They can vary considerably in size and are generally fixed in position. They need to be large enough and close enough to the process to allow for the “spread” of the contaminant-laden air.

The volume flow rate of the hood must exceed the emission / volume flow rate of the source.





C.2.3. Examination and testing:

Visually examine hoods for physical damage, wear and tear, integrity of connection to the ducting and positioning relative to the process and operator.

The use of a smoke tube and /or dust lamp may also be appropriate to assess the control of the contaminant.

Testing would normally include measurement of the face velocity at the hood, static pressure behind the hood and sometimes the capture velocity at the emission source or operator position.

Measured values need to be compared with original data given by the supplier and / or the data gathered on the first inspection, if shown to represent a means of achieving good control, (satisfactory Initial Appraisal / Commissioning) and / or recommended good ventilation practice.

C.3. Enclosures

There are three main types — Full enclosures. partial enclosures and “room” enclosure.

For all three, the process to be controlled takes place within the enclosure.

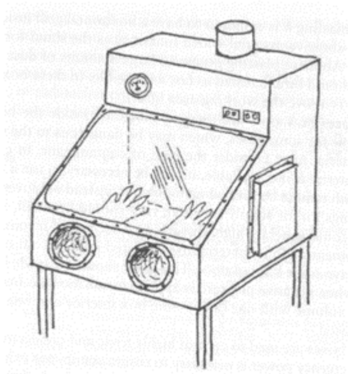
C.3.1. Construction

Enclosures are usually rigid and may be made from metallic, plastic, glass or wooden materials.

The correct choice of material will depend on the application, position and hazardous substance(s) being controlled.

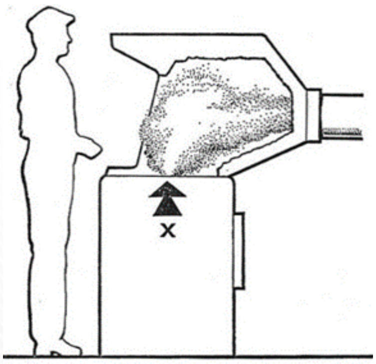
C.3.2. Design

Full enclosures totally enclose the process and leave no route for contaminated air to escape into the workplace. They may contain fully automated or robotized processes.



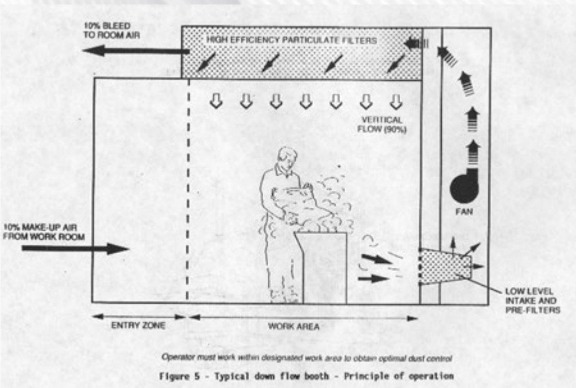
Glove-type Cabinet

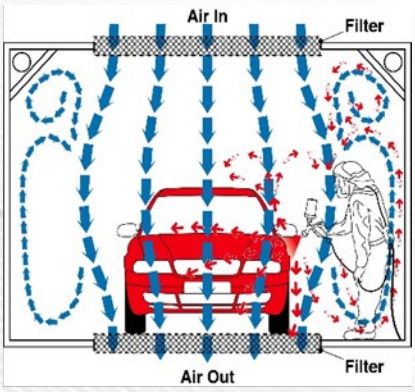
Partial enclosures allow access into the booth but maintain a separation of the process and the operator.



Ventilated Workbench / Fume Cupboard

“Room” enclosures allow operators to be inside with the process.





Sack Emptying Booth

” Down draught” Spray Booth

C.3.3. Examination and Testing:

Visually examine enclosures for physical damage, wear and tear, integrity of door seals and connections to ducting.

Testing would normally include measurement of airflow velocity at the open side of the enclosure and / or operator position and / or filter face.

For full enclosure applications a “clearance time and leakage test” may be required (Paint Spray Booths for example) or indeed advantageous as part of the system intended operating procedure, this is done using a smoke generator and high intensity light beam. The “clearance time” must be prominently displayed at the booth / room / enclosure access points.

Measured values need to be compared with original data given by the supplier/installer and / or the data gathered on the first examination, if shown to represent a means of achieving good control, (satisfactory Commissioning or Initial Appraisal) and / or recommended good ventilation practice.

APPENDIX D — SUPPLEMENTARY PROCEDURES

D.1 Air Sampling

D.1.1 General considerations

For compliance with the Control of Substances Hazardous to Health Regulations, COSHH:

Increasing demands for a clean environment are driving higher standards and it should now be the norm that employers should support the requirements for thorough examinations and tests of LEV systems with regular periodic air sampling, to provide the baseline data for deriving suitable and adequate settings for their control measures. Any change in work process or volume should also be accompanied by air sampling to ensure the LEV systems still provides adequate protection.

Accordingly, where there are airborne contaminants in the workplace, air sampling should be carried out by the employer on a regular basis to ensure Workplace Exposure Limits (WEL) are not exceeded. This is to avoid any of the following circumstances:

A. failure or deterioration of the control measures could result in a serious health effect, either because of the toxicity of the substance or because of the extent of potential exposure, or both;

B. Where there is concern that the WEL (Workplace Exposure Limit) or any self-imposed (in-house) working standard may be exceeded;

C. as an additional check on the effectiveness of any control measure provided in accordance with COSHH regulation 7, and always in the case of the substance or process specified in COSHH Schedule 5 (i.e. Vinyl chloride monomer or spray given off from vessels at which an electrolytic chromium process is carried on, except trivalent chromium);

D. when any change occurs in the conditions affecting employee's exposure which could mean that adequate control of exposure is no longer being maintained, e.g. an increase in the quantity of a substance used or changing systems of work or introducing new plant.

Air sampling may also be required, under particular circumstances, for compliance with the Control of Asbestos Regulations and the Control of Lead at Work Regulations.

Air sampling is a method for determining the respirable and/or inhalable concentration(s) of hazardous substance(s) in the workplace air. To be of use, data gathered during sampling must be representative of the actual exposures experienced by the workers. This can assist in judging the performance of LEV as an applied control measure.

Sampling is taking a known volume of air through a filter medium, (normally a paper for solids and a sorbent for gases), where the contaminant is captured. A volume of air and an amount of pollutant will give a result as a concentration, expressed as either milligrams per cubic metre (mg/m3) or parts per million (ppm).

Personal sampling involves the collection of samples from the workers breathing zone. It is undertaken where results are to be compared against standards. The advantage of this type of sampling is that it provides a measure of the actual dose received, even if the job requires the worker to move between processes/activities during the shift.

Note: Only personal sampling results can be compared directly with Occupational Exposure Limits such as those in EH40 Workplace exposure limits.

Workplace exposure limits, WELs, are occupational exposure limits set under COSHH and are concentrations of hazardous substances in air, averaged over a specified period of time referred to as a time-weighted average (TWA). Two time periods are used: long term (8 hours) and short term (15 minutes).

D.1.2. Air Sampling Methods

There are a number of different ways of taking air samples, but the most widely used and preferred is to connect a battery-operated pump to a filter medium, fixed within the breathing zone. The duration of the sampling will depend on a number of considerations including the method employed, the process/activity pattern and the substance(s) being sampled.

D.1.3 Filter sampling inhalable/respirable dust: (Aerosol, dust, fume, smoke, mist)

Air is drawn through a filter paper which catches the solid particulate, e.g. dust, aerosols and fibres. To separate total inhalable dust from respirable dust, an additional foam filter would be used in the sampling head. Analysis is usually done by weight gain of the filter(s), (gravimetric), but further analysis for specific chemicals can also be carried out.

D.1.4 Sorbent sampling: (Vapour, gas)

Air drawn through the tube is pulled through the sorbent which captures the molecules of the gas or vapour. Sorbents are normally contained in a small diameter glass tube with sealed ends. The trapped contaminants are released by solvent washing or heat to a gas chromatograph for analysis.

D.1.5 Passive sampling : (Vapour, Gas)

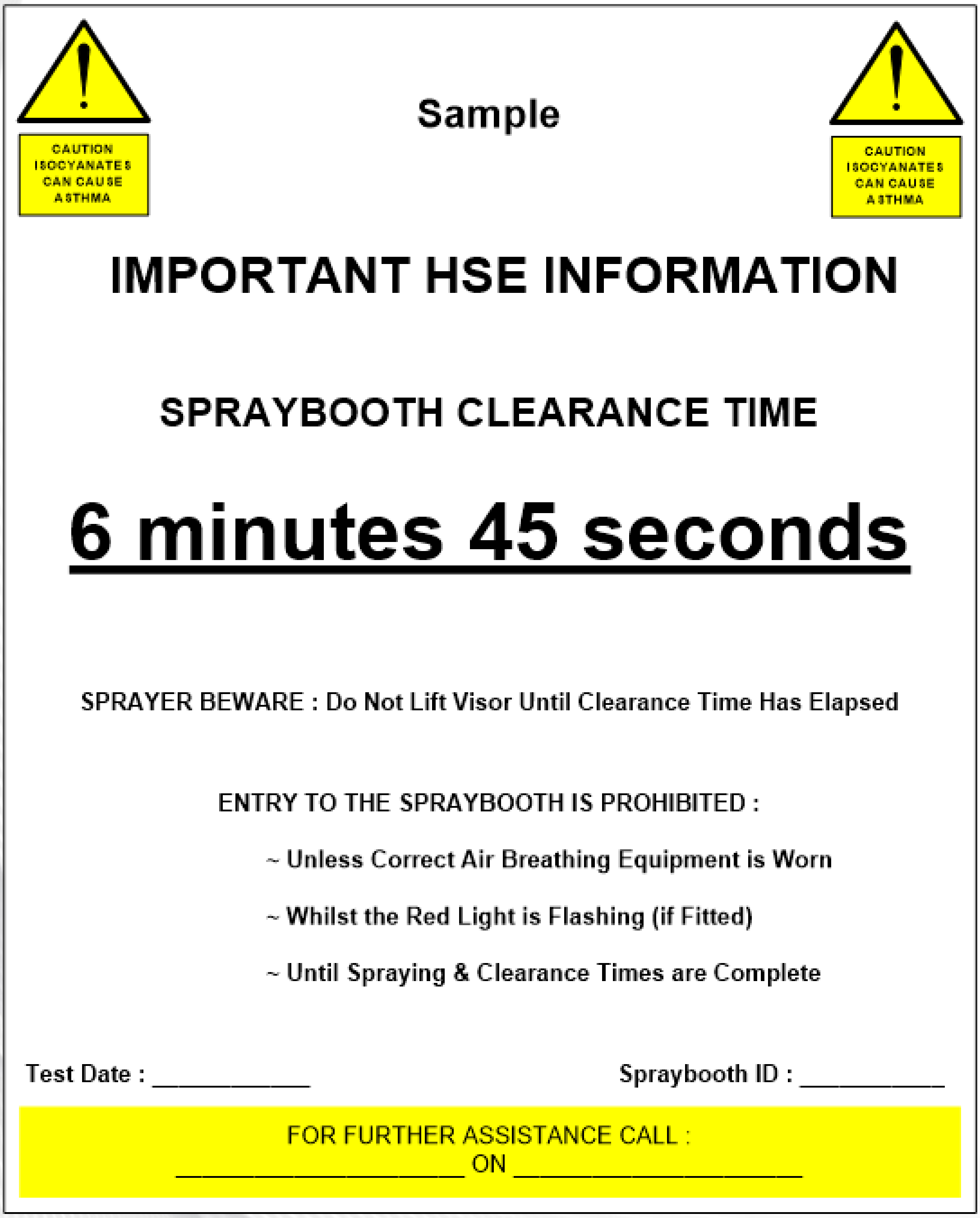
This is another commonly used technique. Passive badges or passive colour change tubes, which can be clipped to the workers collar, contain a chemical agent which is designed to absorb the specific contaminant at a known rate. Badges will require laboratory analysis, but colour change tubes give a value from the marked scale.

D.1.6 Direct reading sampling: (Dust, vapour, gas)

A variety of equipment is available to give an "instantaneous" value to the contaminant. These include dust monitors, grab samplers and gas detectors.

D.2 Clearance time and leakage test

Set up the booth, room or enclosure for normal operation (e.g. all doors closed etc.). The area should be empty i.e. no vehicle / components, to avoid possible contamination. Fill the area evenly with smoke so that the opposite side cannot be seen. Check externally for leaks. Replenish smoke if necessary. Turn on the extraction system and start the timer. Use a lamp within the area and observe the clearance pattern. When the area is completely clear of smoke, record the time. Round up the measured time to the next quarter minute. This is the "clearance time" which should be clearly displayed at each access point in the form of a clear certificate. See sample notice below. Ideally, this test should be carried out just before the filters are due to be changed or cleaned to give a "worst case" scenario. Suitable airflow measurements e.g. face velocities at exhaust filters and the static pressure at the fan inlet should be recorded to qualify current performance conditions.



CAUTION ISOCYANATES CAN CAUSE ASTHMA

Sample

CAUTION ISOCYANATES CAN CAUSE ASTHMA

IMPORTANT HSE INFORMATION

SPRAYBOOTH CLEARANCE TIME

6 minutes 45 seconds

SPRAYER BEWARE : Do Not Lift Visor Until Clearance Time Has Elapsed

ENTRY TO THE SPRAYBOOTH IS PROHIBITED :

~ Unless Correct Air Breathing Equipment is Worn

~ Whilst the Red Light is Flashing (if Fitted)

~ Until Spraying & Clearance Times are Complete

Test Date : ___________ Spraybooth ID : __________

FOR FURTHER ASSISTANCE CALL :
____________________ ON ____________________

Sample Clearance Time Notice.

D.3 Filter efficiency

Every filter should be matched with the contaminant(s) that it is intended to control which is essential for all systems where the exhaust is directed either to the Atmosphere or returned to the workplace (re-circulating).

This should be determined at the design stage of the LEV ensuring the filter efficiency (as defined by the manufacturers regarding particulate size) prevents ‘short-circuit’ or ‘filter by-pass’.

Every filter should ideally be marked with its filter classification, for example H14, but should at least be supported by relevant certification.

Filter condition can be checked for its condition (visual examination and Tyndall beam test on the exhaust) at the time of the Thorough Examination and Test (TExT), where it remains the responsibility of the ‘Duty Holder’ (Employer) to fulfil their obligations to confirm and monitor suitability (Paragraph 189 of COSHH refers).

In the event this cannot be evidenced at the time of the TExT the Duty Holder should be advised accordingly.

The following filter standards refer;

- Device Standard BS EN ISO 15012-1 Health and safety in welding and allied processes. Equipment for capture and separation of welding fume. Requirements for testing and marking of separation efficiency
- Device Standard BS EN 60335-2-69Household and similar electrical appliances. Safety. Particular requirements for wet and dry vacuum cleaners, including power brush for commercial use
- BS EN ISO 16890-1- Air filters for general ventilation. Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM) (replaces BS EN 779:2012)
- BS EN 1822-1 High efficiency air filters (EPA, HEPA and ULPA). Classification, performance testing, marking
- ASHRAE 52/2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. - minimum efficiency reporting value (MERV)

Notes;

1. Filter efficiency is determined typically as a percentile and is only guaranteed at the time of manufacture. The following examples are those that would adversely affect the maintenance of the specified efficiency;

A. Incorrect fitting

B. Saturation

C. Change of process and/or contaminant type

D. Damage or deterioration

E. Exceeding of ‘shelf-life

2. With Welding fume now classified as carcinogenic, the determination of filter type and condition is imperative A solution is to avoid ‘re-circulation’ of the exhaust air to any workplace area

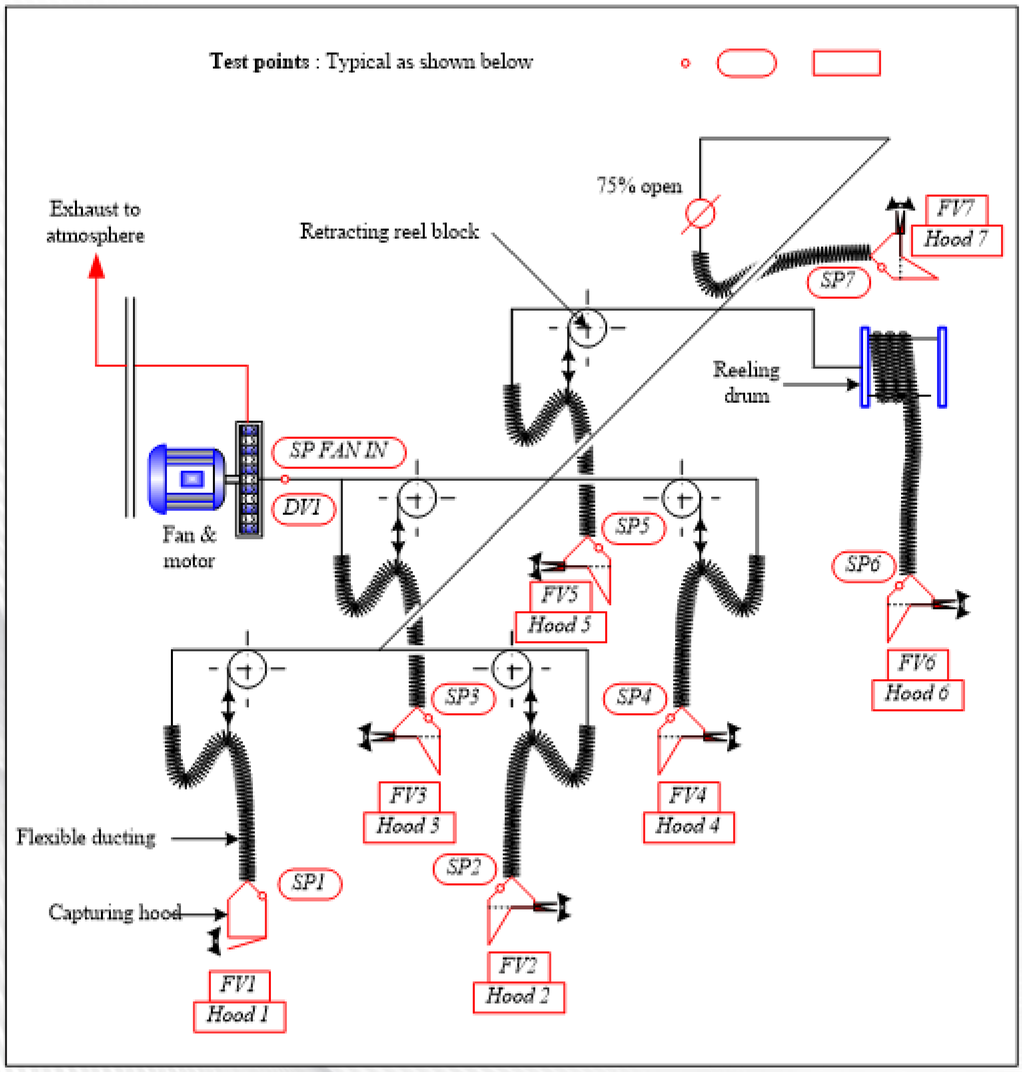
APPENDIX E — PROCESSES UNDER EXAMINATION AND TEST

E.1. Fume extraction systems — Sample process guide

E.1.1 Vehicle exhaust extraction whilst engines are running

Periodicity: 14 Monthly.

Substances: Petrol, diesel and LPG vehicle fumes.



Air sampling: According to risk assessment – medium to low risk. See appendix D1:

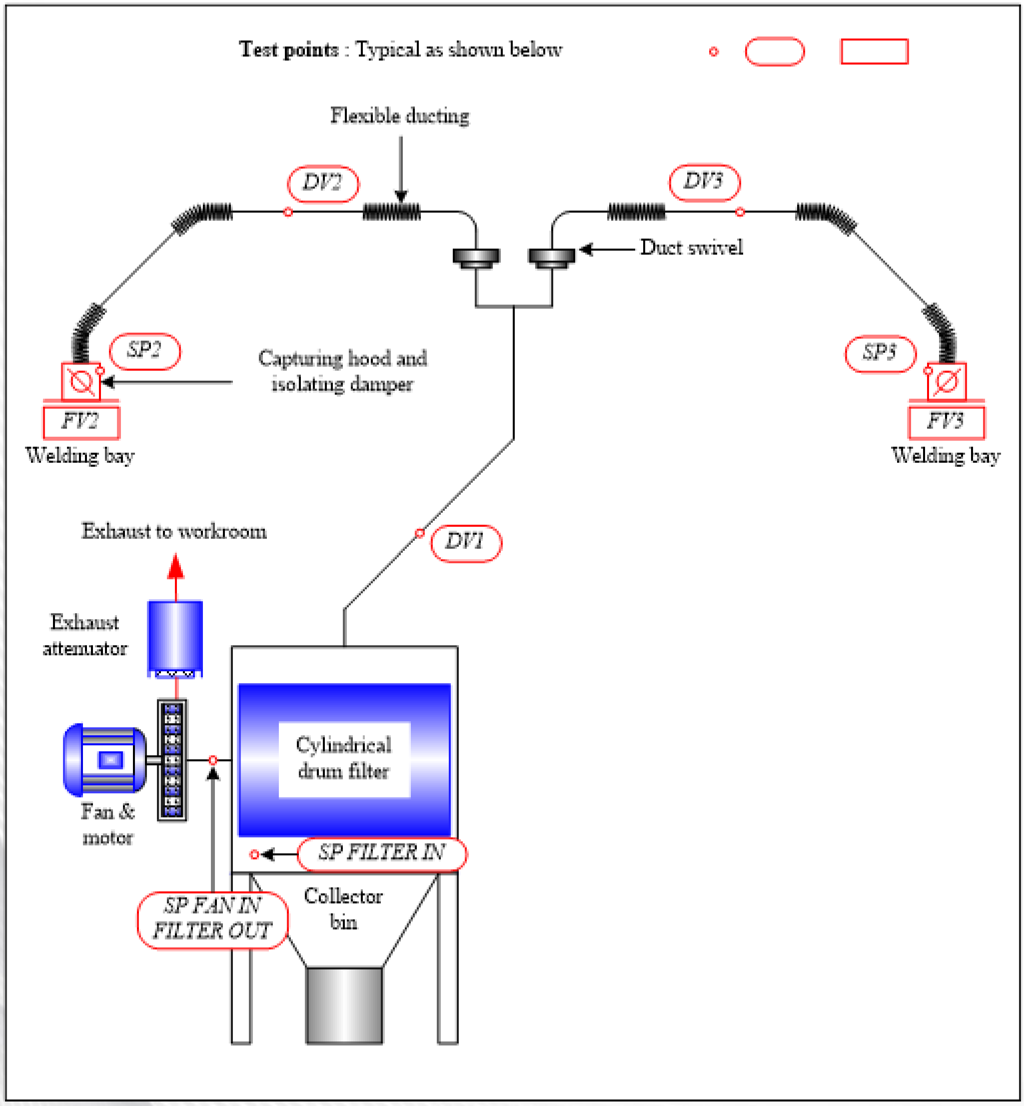
Typical problems:

- Congested — Fan inlet, particle grilles (if fitted) behind captor hoods, exhaust stack,
- Damaged/holed — Capturing hoods, flexible ducting, captor exhaust ‘grabbers’ (usually from vehicle movements),
- Incorrect operation — Fan rotation incorrect,
- Specification — Type of use, preventative maintenance,
- Incorrect use — Captors not fitted correctly to exhaust tail pipes

E.1.2 Welding

Periodicity: 14 monthly.

Substances: Welding process fumes.



Air sampling: See Appendix D.1.

Typical problems:

- Congested — Fan inlet, drum filter, ducting,
- Damaged/holed — Filters, enclosure, captor hoods, flexible ducting, isolating dampers, ducting articulated joints,
- Incorrect operation — Fan rotation incorrect, filter clean motor rotation incorrect or inoperative,

- Specification — Type of use, preventative maintenance,
- Incorrect use — Capturing hoods not positioned correctly for process substance capture.

Note;

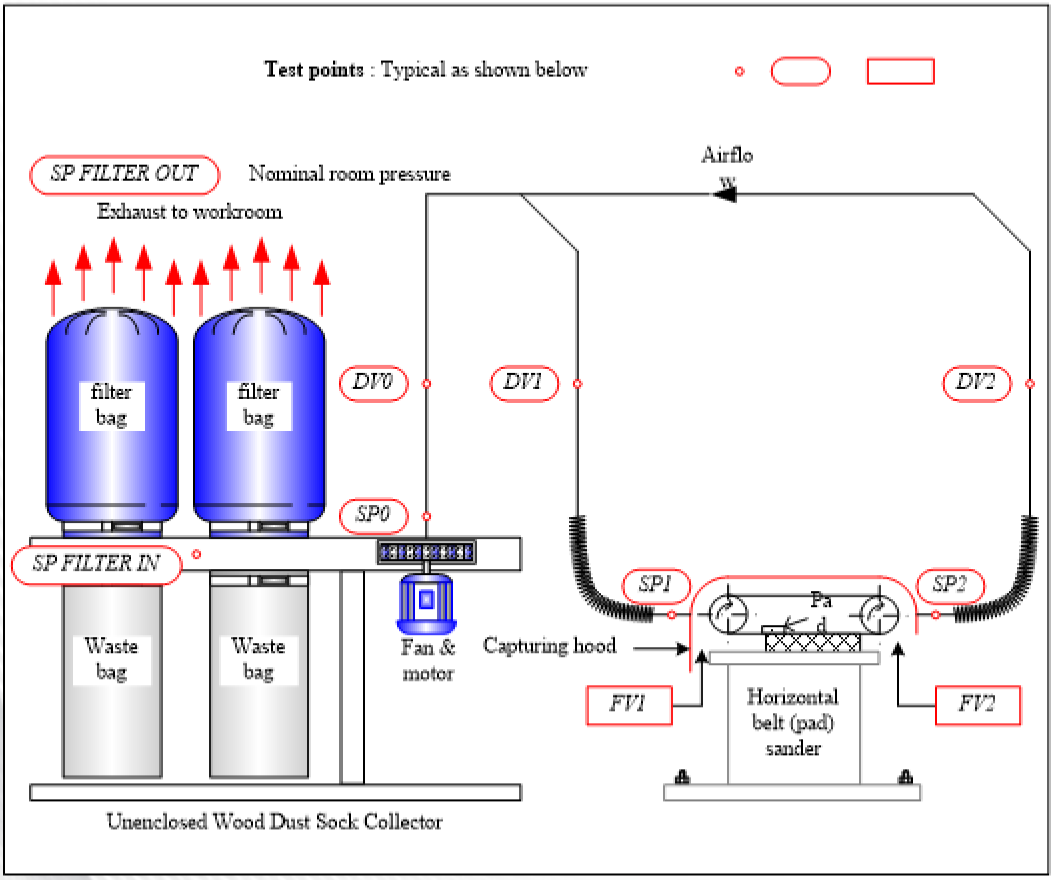
With Welding fume now classified as carcinogenic, the determination of filter type and condition is imperative (section D.3 refers). A solution is to avoid ‘re-circulation’ of the exhaust air to any workplace area.

E.2. Dust extraction systems — Sample process guide

E.2.1 Woodworking — Horizontal belt sander

Periodicity: 14 monthly.

Substances: Hard and soft wood dust.



Air sampling: See Appendix D.1.

Typical problems:

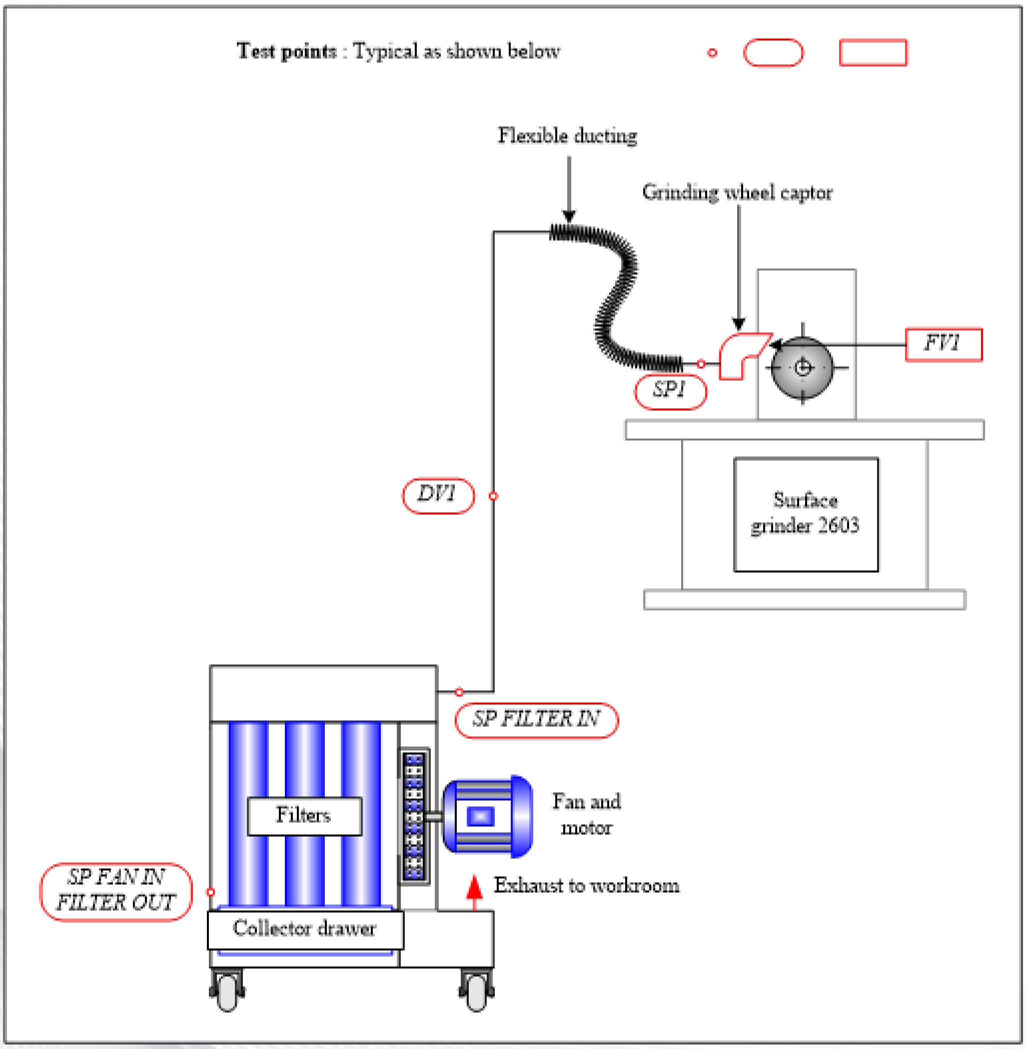
- Congested — Fan inlet, filter bags, collector bags, ducting,
- Damaged/holed — Filter bags, collector bags, capturing hoods, ducting,
- Incorrect operation — Fan rotation incorrect, filter and collector bags of incorrect size and type,
- Specification — Type of use, preventative maintenance,
- Incorrect use — Poor sealing and securing of filter and collector bags

E.2.2 Metal abrading — Surface grinding

Periodicity: 6 monthly: Abrading, grinding or polishing metals in any room for more than 12 hours in any week

14 monthly: Abrading, grinding or polishing metals in any room for less than 12 hours in any week

Substances: Specified grinding dust.



Air sampling: See Appendix D.1.

Typical problems:

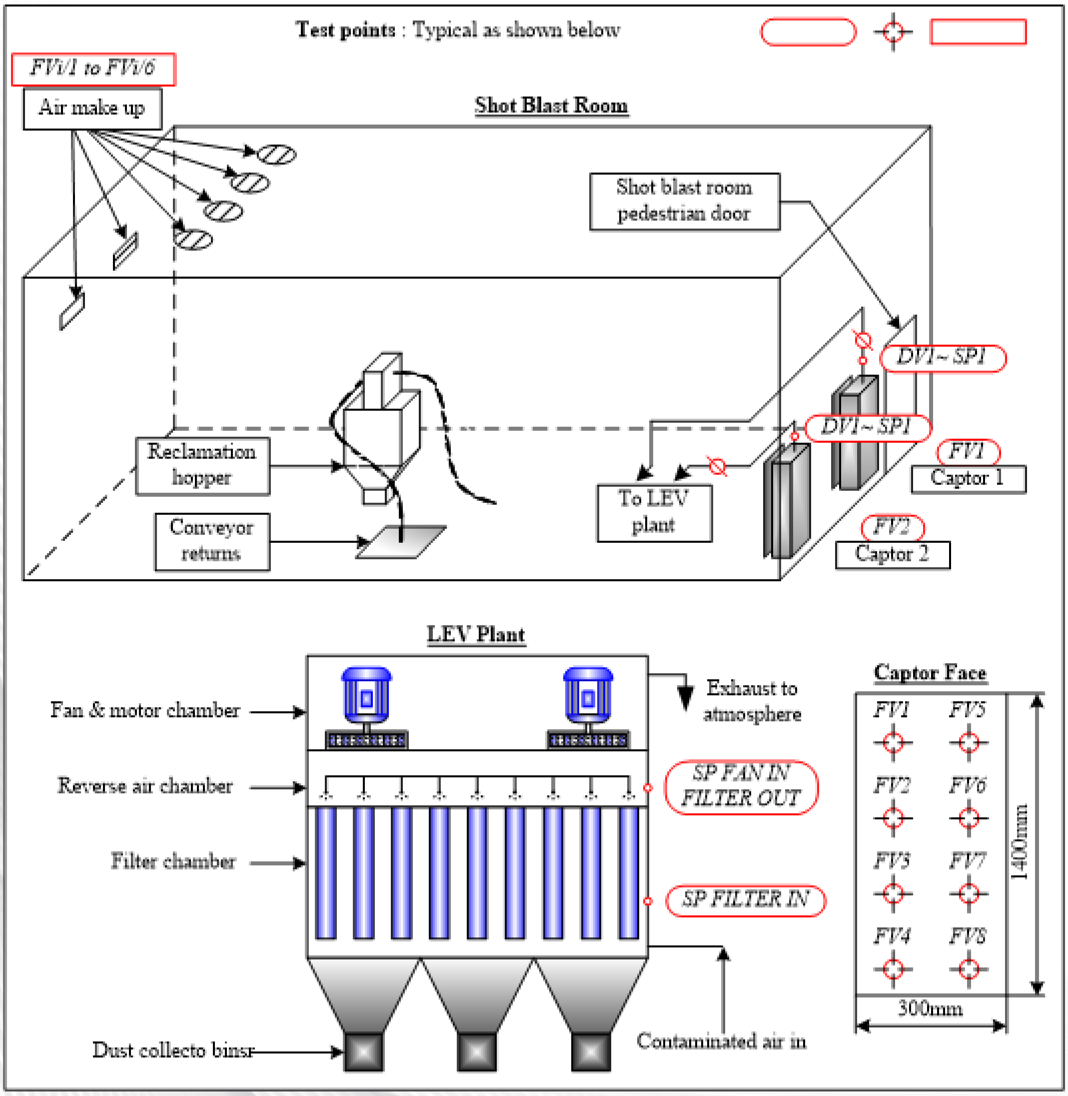
- Congested — Filter bags / sleeves, collector drawer, ducting, capturing hoods,
- Damaged/holed — Enclosure, filter bags, sleeves, capturing hood, ducting, electrical cables and plugs,
- Incorrect operation — Fan rotation incorrect, inoperative filter cleaner,
- Specification — Type of use, preventative maintenance,
- Incorrect use — Contaminated filters from wet processes.

E.3. Shot blast systems — Sample process guide

E.3.1 Room type — Component cleaning or abrading

Periodicity Monthly: New castings — 6 monthly: Abrading metals — 14 monthly: Remainder.

Substances Component material and shot blast media — Steel, silica, nut shells, glass beads, etc.



Air sampling: Not a normal requirement providing — Operators wear air-fed masks. See Appendix D1.

Typical problems:

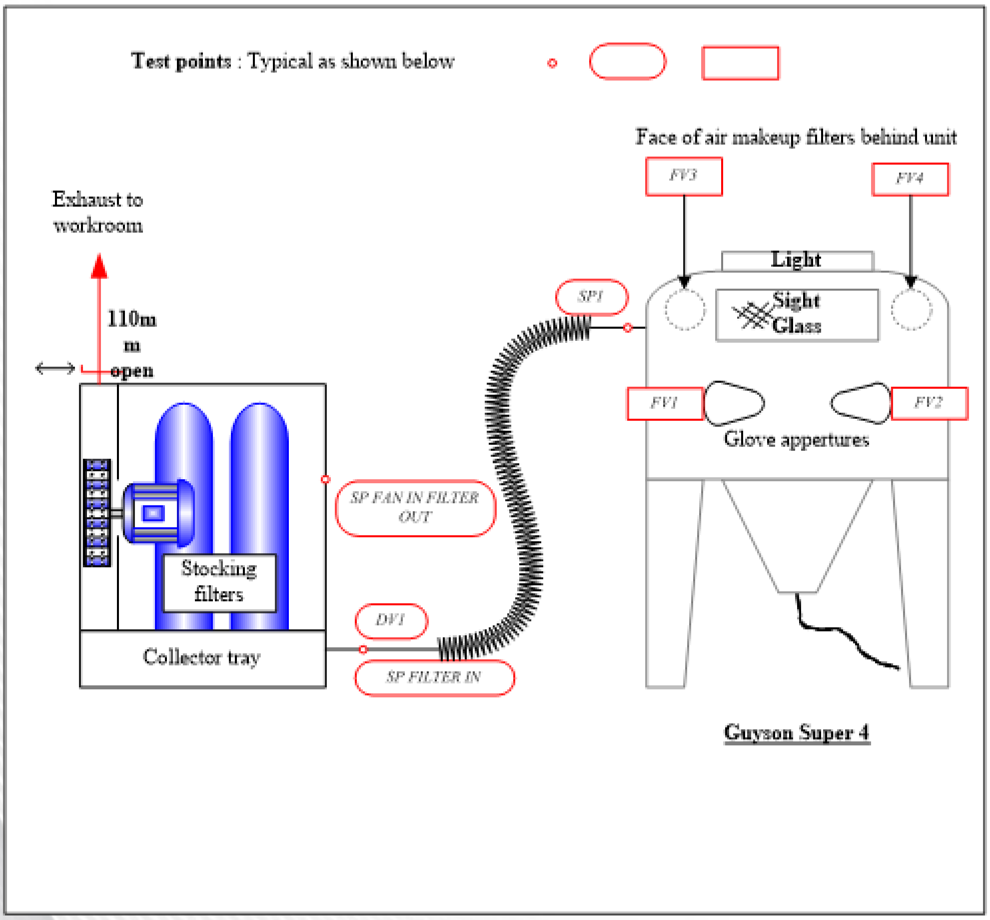
- Congested — Filters, collector bins, ducting,
- Damaged/holed — Cabinet, chamber, door seals, ducting, filters,

- Incorrect operation — Fan rotation incorrect, filter cleaner defective,
- Specification — Incorrect filters, type of use, preventative maintenance,
- Incorrect use — User error during operation or maintenance.

E.3.2 Glove type — Component cleaning or abrading

Periodicity: Monthly: New castings — 6 monthly: Abrading metals — 14 monthly: Remainder.

Substances: Component material and shot blast media — Steel, silica, nut shells, glass bead, etc.



Air sampling: See Appendix D.1.

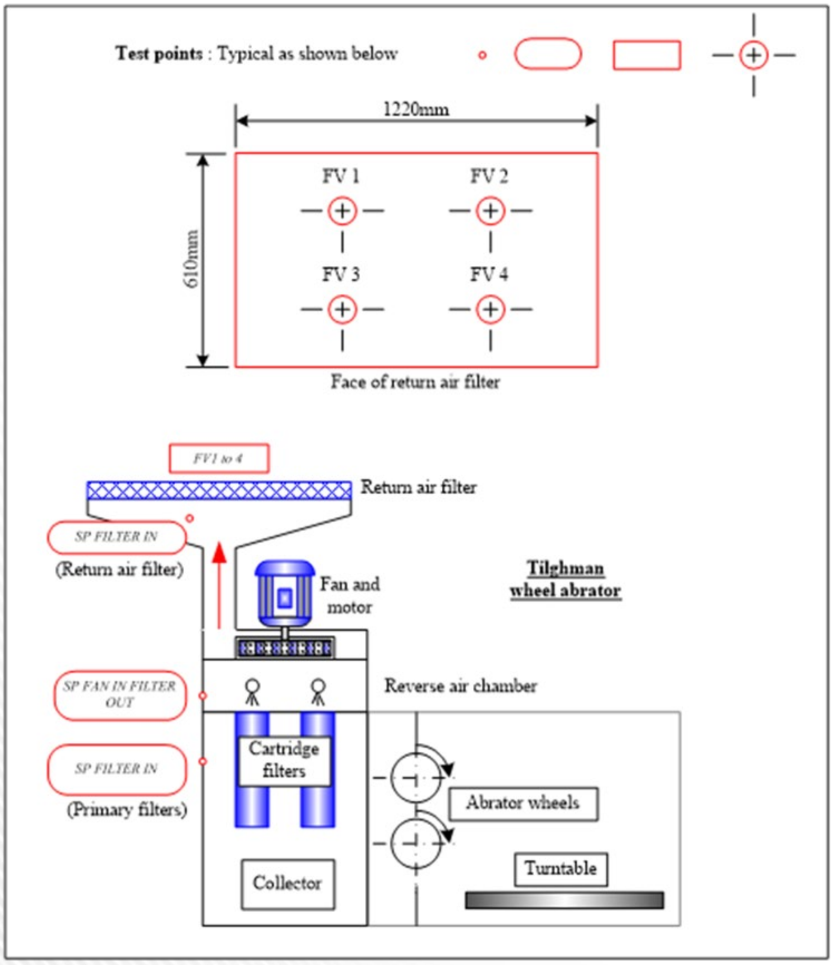
Typical problems:

- Congested — Filters, collector trays, ducting,
- Damaged/holed — Cabinet, chamber, door seals, ducting, filters,
- Incorrect operation — Fan rotation incorrect, filter cleaner defective,
- Specification — Incorrect filters, type of use, preventative maintenance,
- Incorrect use — User error during operation or maintenance.

E.3.3 Machine type — Component cleaning or abrading

Periodicity: Monthly: raw castings — 6 monthly: Abrading metals — 14 monthly: Remainder.

Substances: Component material and shot blast media — Steel, silica, nut shells, glass beads, etc.



Air sampling: Not a normal requirement — Process enclosed

Typical problems:

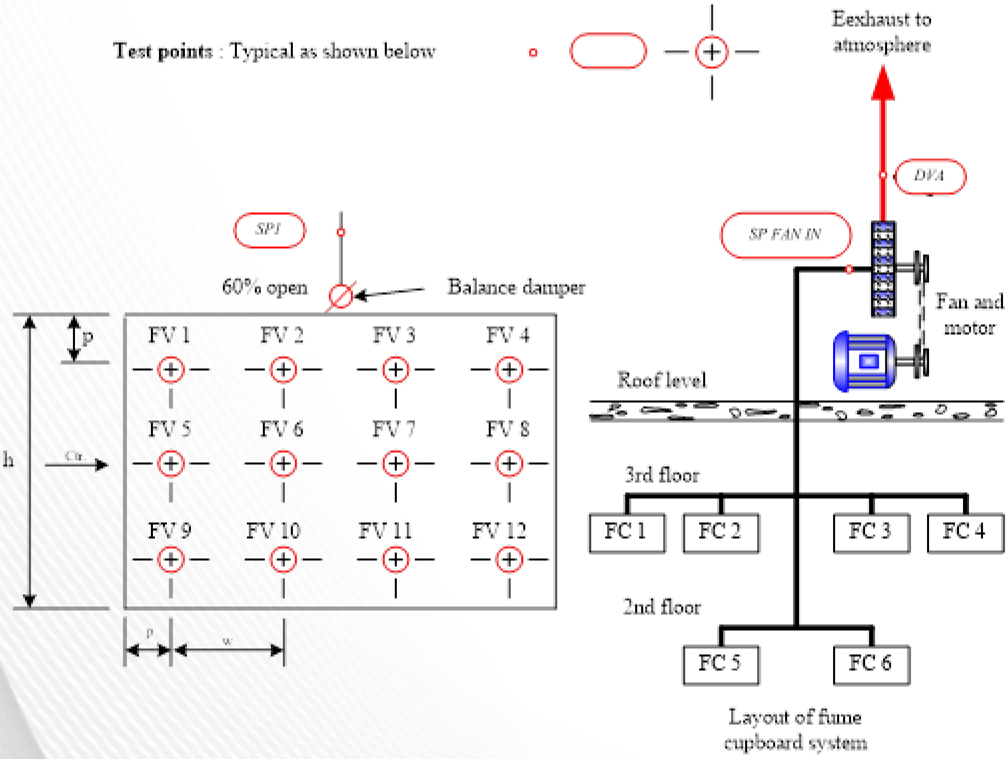
- Congested — Filters, dust collector,
- Damaged/holed — Enclosures, chamber linings, door seals, filters, abrator wheels,
- Incorrect operation — Fan rotation incorrect, filter cleaner defective, inoperative turntable door interlock,
- Specification — Incorrect filters, type of use, preventative maintenance,
- Incorrect use — User error during operation or maintenance.

E.4. Fume cupboards — Sample process guide

E.4.1 Multiple system (negative pressure ducting) — Chemical decanting, storing and laboratory working

Periodicity: 14 monthly.

Substances: Acids solvents, mixed fume and gases, etc.



Cupboard Number: FC1

Face Readings. *Average face velocity readings obtained by dividing face of fume cupboard into a grid.*
Key. p = Perimeter reading 75 mm   Ctr. = Half of working sash height.
w = Never greater than 350 mm   h = Working sash height.

Air sampling: Is not a normal requirement, however, see Appendix D.3.

Additional Measurements: Units fitted with a by-pass, sash set at minimal open height (approximately 200 mm), average FV at face should not rise by more than 50% of original face average reading.

Typical problems:

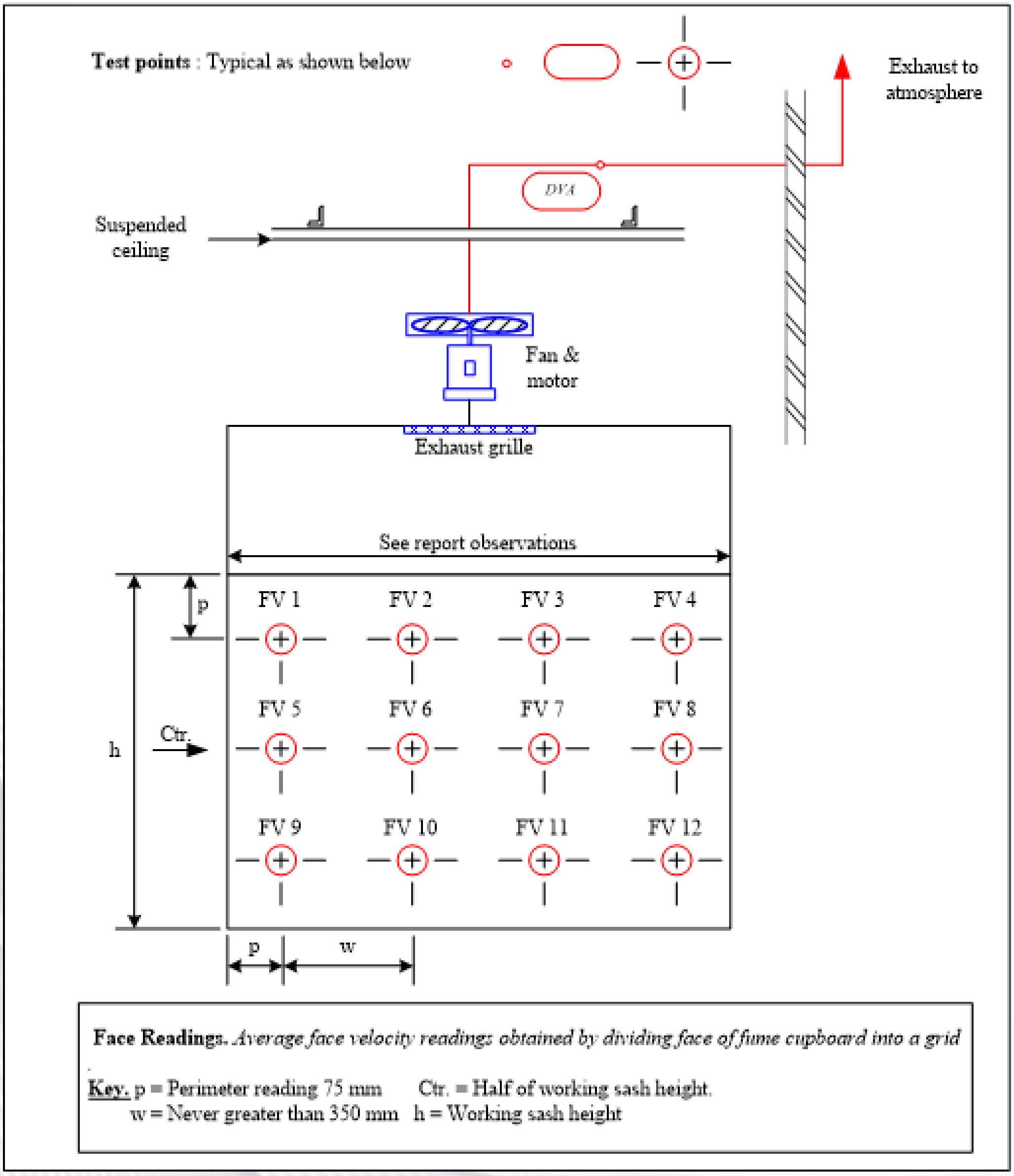
- Congested — Fan inlet, balance control dampers,

- Damaged/holed — Enclosures, sash doors, ducting, exhaust stack, cupboard seals,
- Incorrect operation — Fan rotation incorrect, inoperative air flow indicator, insufficient 'make up' air,
- Specification — Incorrect for type of use, preventative maintenance,
- Incorrect use — By location — influence from doors, windows, air handling plant.

E.4.2 Single system (positive pressure ducting) — Chemical decanting, storing and laboratory working

Periodicity: 14 monthly.

Substances: Acids solvents, mixed fume and gases, etc.



Air sampling: Is not a normal requirement, however, see Appendix D.3.

Typical problems:

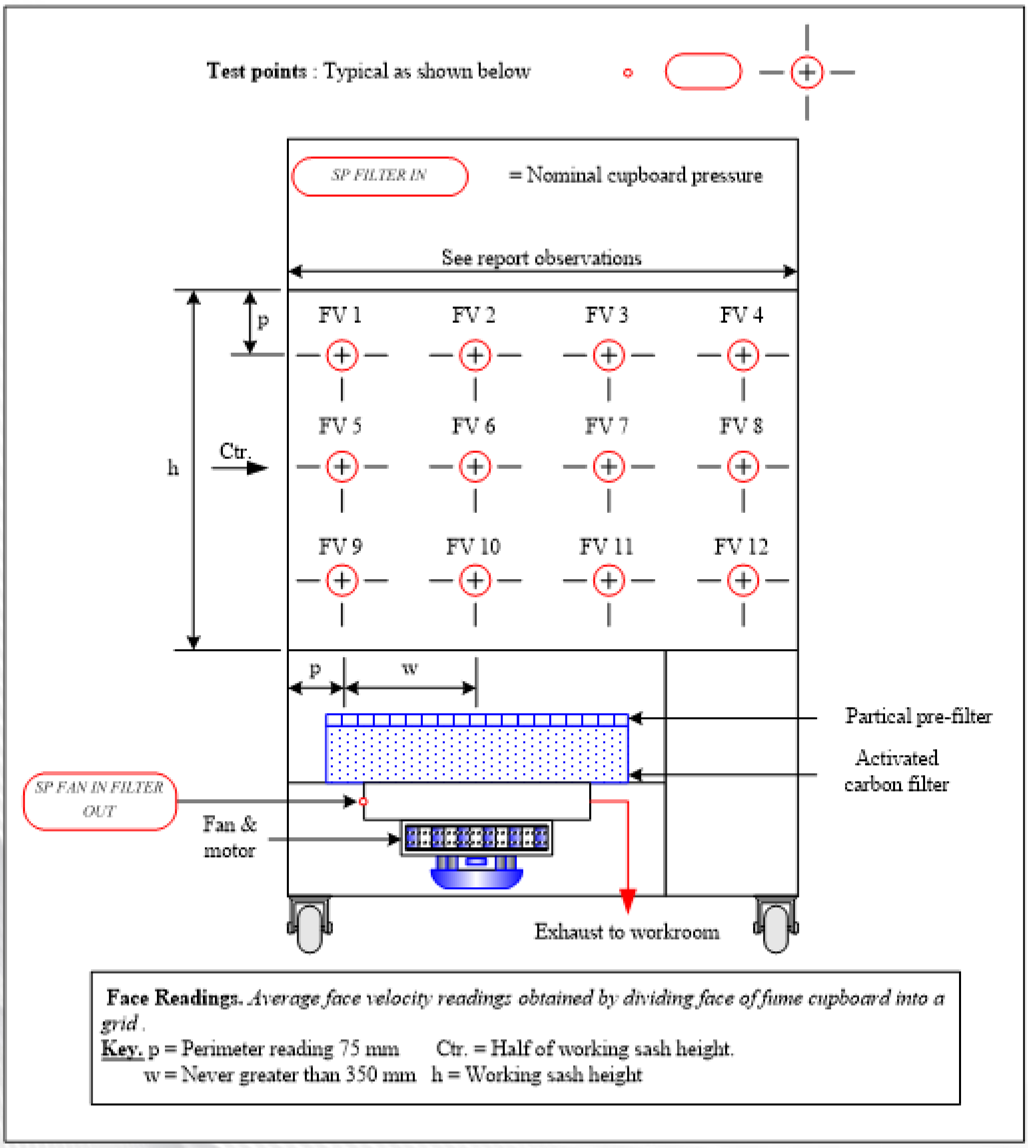
- Congested — Fan inlet, exhaust stack,

- Damaged/holed — Enclosures, sash doors, exhaust stack, cupboard seals, ducting, (any holed ducting within false ceilings, internal risers will permit captured substance to escape to rooms),
- Incorrect operation — Fan rotation incorrect, inoperative air flow indicator, no marked or sash door stops at suitable working height, insufficient room air make up,
- Specification — Predominantly in schools, Incorrect for type of use, preventative maintenance,
- Incorrect use — By location — influence from doors, windows, air handling plant.

E.4.3 Re-circulatory system — Chemical decanting, storing and laboratory working

Periodicity: 14 monthly.

Substances: Acids solvents, mixed fume and gases, etc.



Air sampling: Not a normal requirement but should be justified by a risk assessment. For recirculatory fume cupboards used in schools up to 'A' Level standard, CLEAPSS Guide G9, describes the method for carrying out filter saturation tests.

Typical problems:

- Congested — Filters,

- Damaged/holed — Enclosure, neutralising filters life expired, sash door, cupboard seals,
- Incorrect operation — Fan rotation incorrect, inoperative air flow indicator, no marked or sash door stops at suitable working height, insufficient 'make up' air,
- Specification — Incorrect filters, type of use, preventative maintenance,
- Incorrect use — By location — influence from doors, windows, air handling plant.

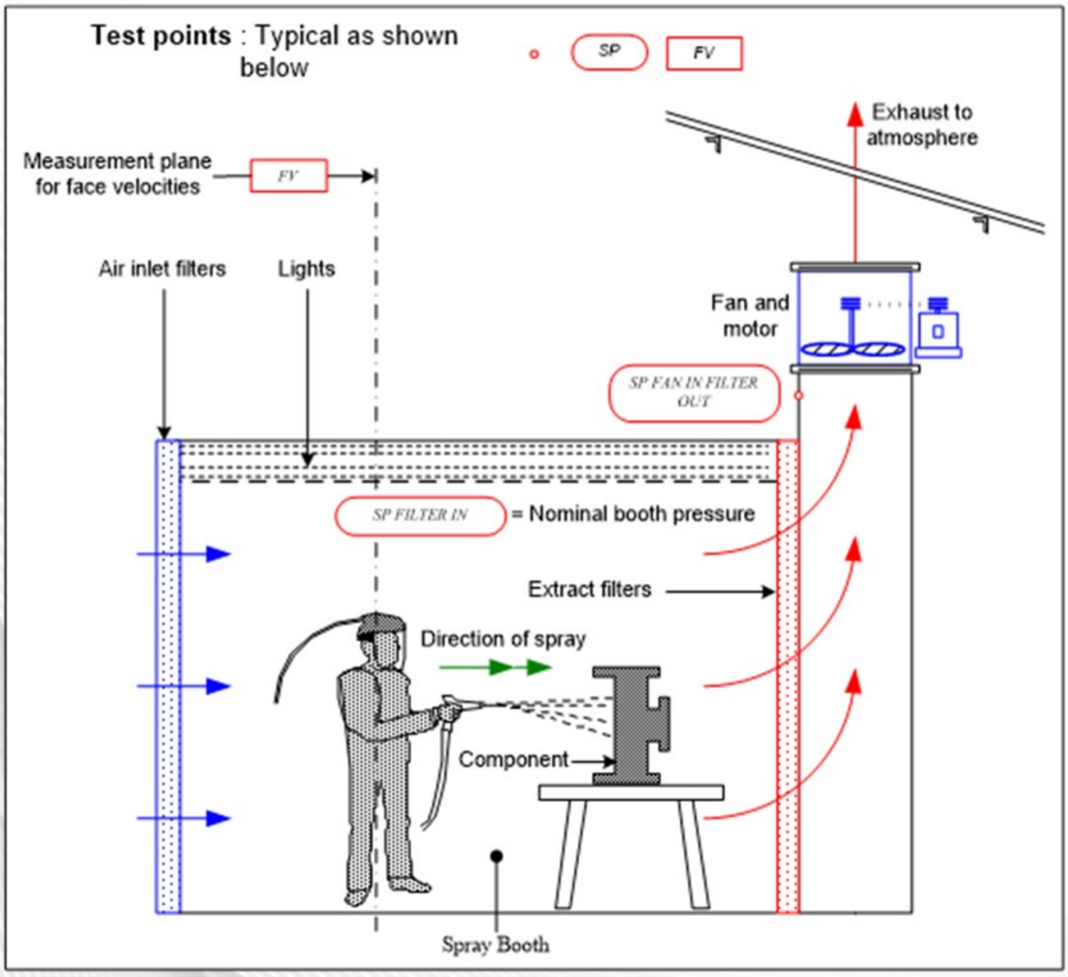
E.5. Surface coatings — Sample process guide

E.5.1 Room type side draught spray booth — Paint spray booth, component spraying.

Periodicity: 14 monthly — includes booth clearance time and leakage test.

Substances: Isocyanate, paint and thinner fumes.

Potential hazards: Explosive atmosphere, Occupational asthma.



Test methodology: See Appendix D.2.

Air sampling: See Appendix D.1.

Typical problems:

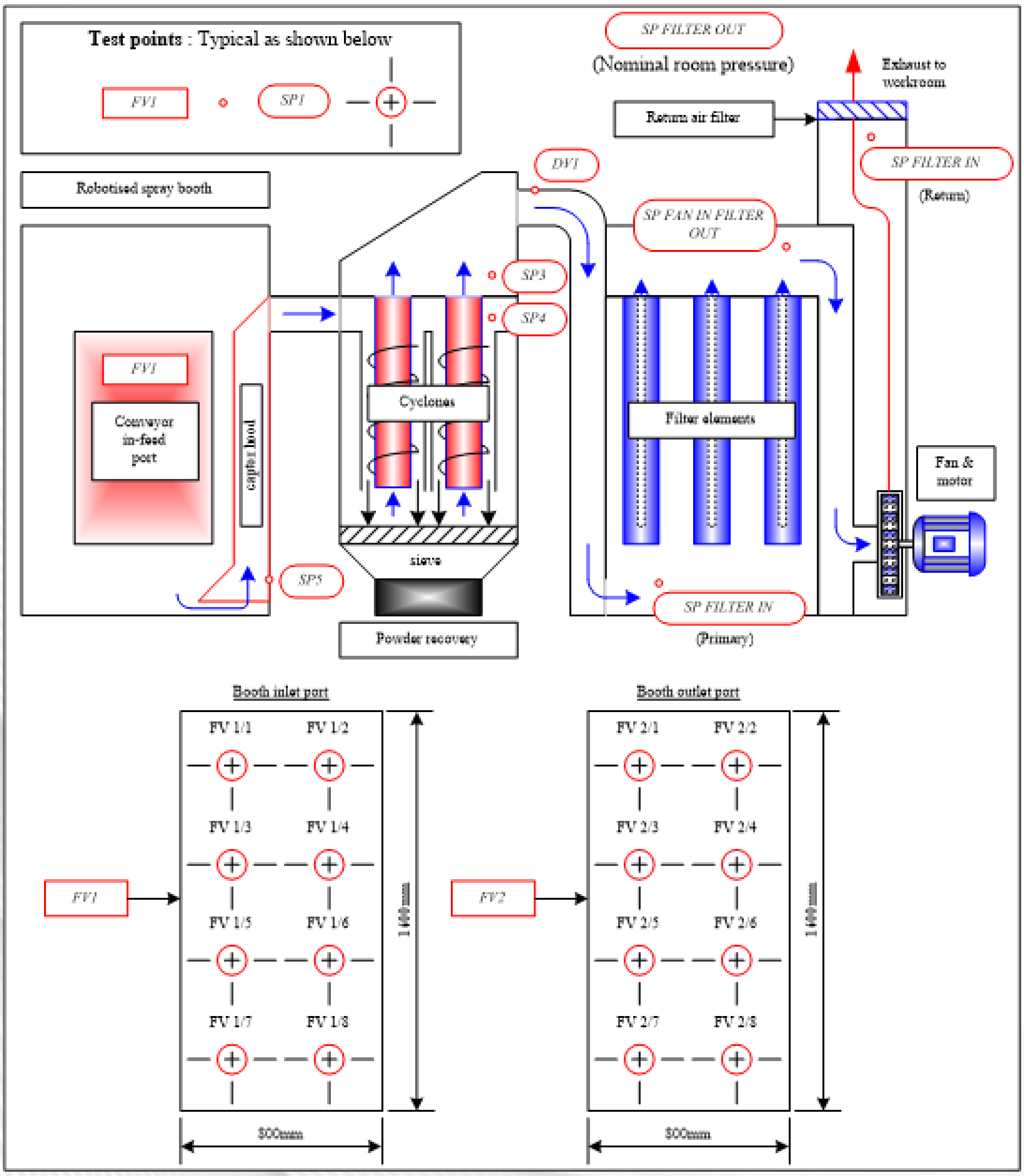
- Congested — Filters,
- Damaged/holed — Enclosure door seals, filters, lights,

- Incorrect operation — manometer and air flow alarms/indicators inoperative, fan not running at rated speed,
- Specification — Incorrect filters, type of use, preventative maintenance, booth clearance time displayed,
- Incorrect use — Directional spraying away from exhaust filters, booth not being maintained at negative pressure.

E.5.2 Robotised automated spray booth — Paint spray booth, component spraying.

Periodicity: 14 monthly — includes booth clearance time and leakage test.

Substances: Polyester powder paint (TGIC free).



Test methodology: Sufficient face velocities should be taken at both in-feed and out-feed ports to confirm substance containment. Static pressures across all arrestors are required to determine filter condition and possible system congestion. Duct velocity at suitable point should be taken to confirm substance is transported and suspended in the air stream.

Air sampling: See Appendix D.2.

Typical problems:

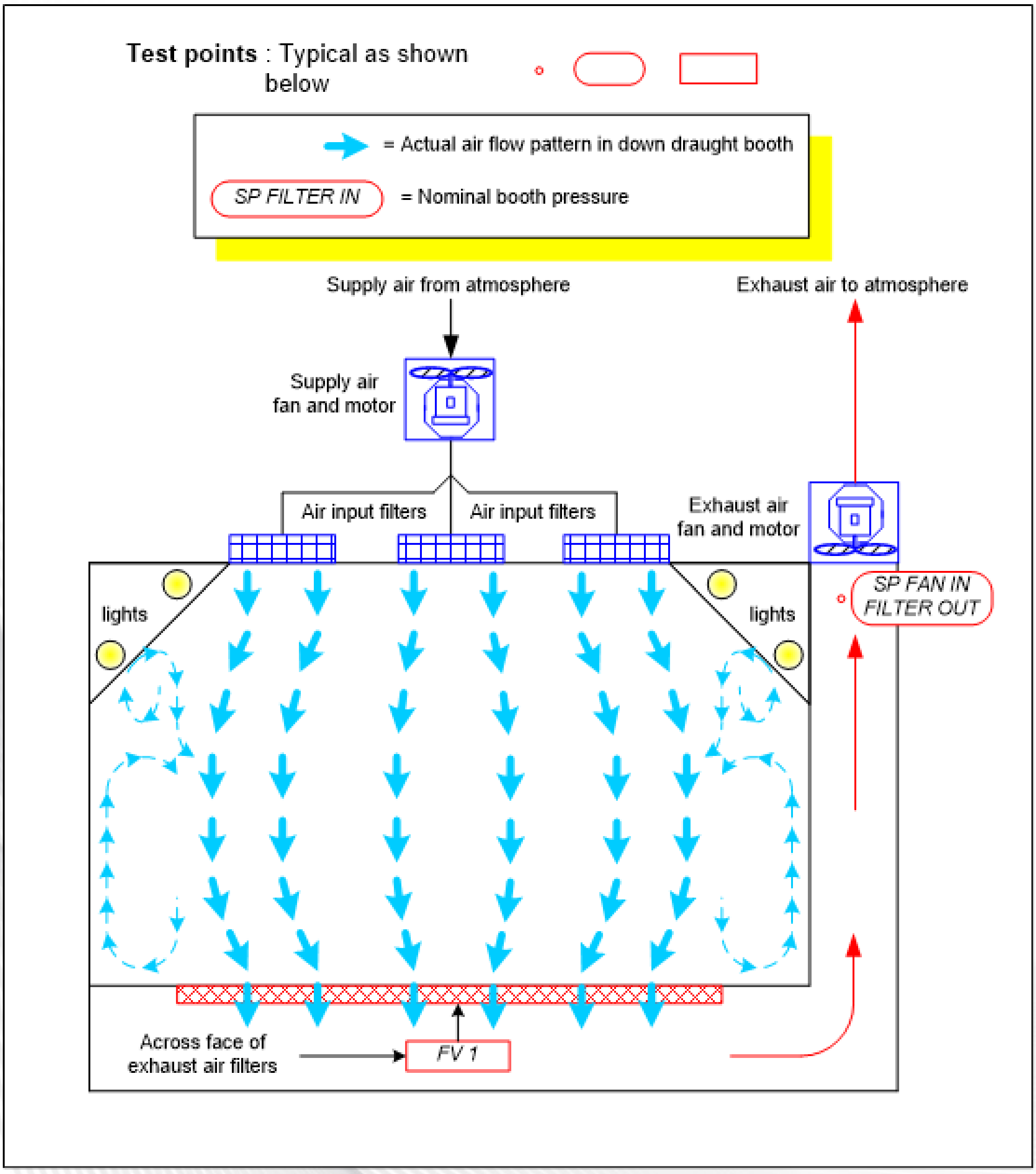
- Congested — Filters, powder recovery, cyclones,
- Damaged/holed — Enclosures, conveyor screens, filters, door seals, lights,
- Incorrect operation — Fan rotation, manometer and air flow alarms/indicators inoperative, influence from space heaters, air handling units and/or open roller shutter doors,
- Specification — Incorrect filters, type of use, preventative maintenance, booth clearance time displayed,
- Incorrect use — Booth not being maintained at negative pressure.

E.5.3 Room type automotive down draught spray booth

Periodicity: 14 monthly — includes booth clearance time and leakage test.

Substances: Isocyanate paint and thinner fumes.

Potential hazards: Explosive atmosphere. Occupational asthma.



Note: Image air flow paths are representative only and not indicative of how all booths will operate

Test methodology: See Appendix D.2.

Air sampling: See Appendix D.1.

Typical problems:

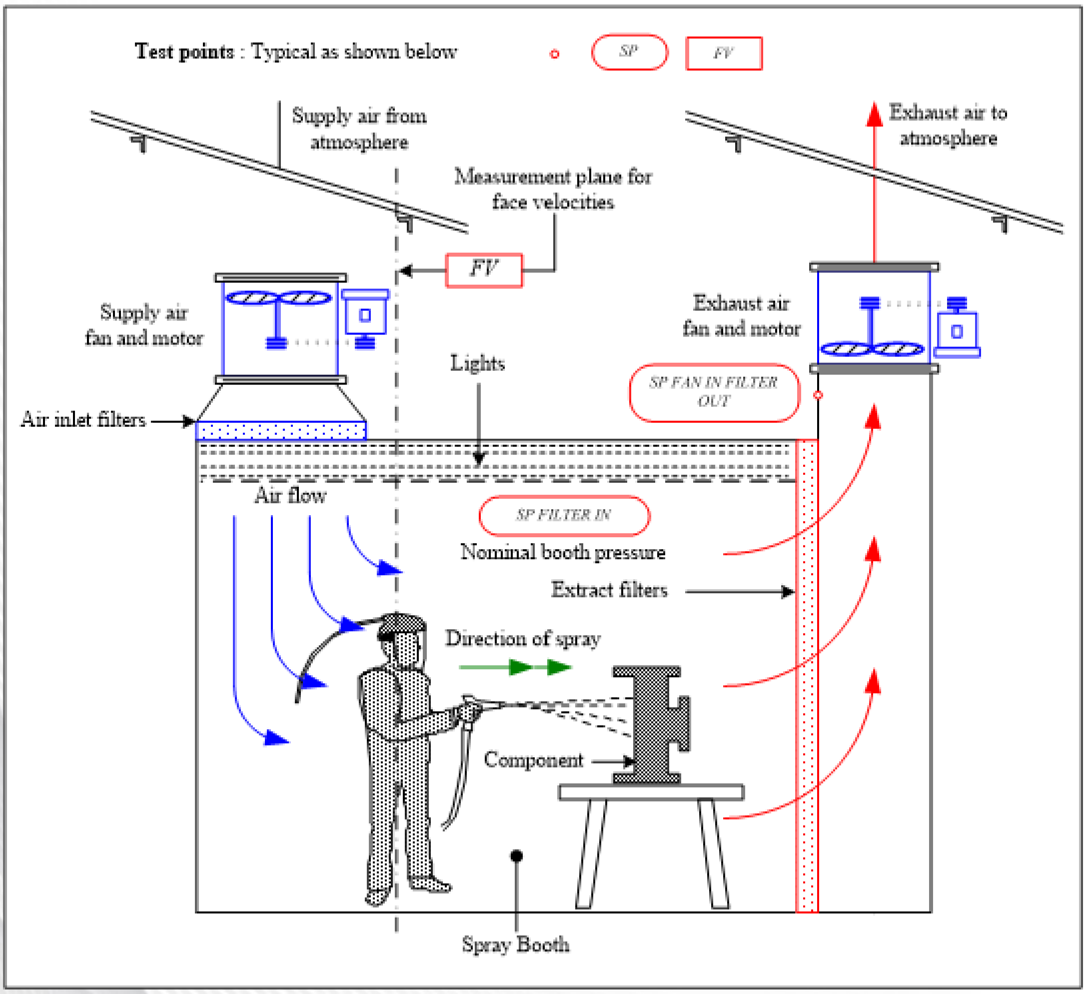
- Congested — Filters. An indicating manometer of alarm should be fitted to monitor booth is maintained at a negative pressure,
- Damaged/holed — Enclosure door seals, filters, lights,
- Incorrect operation — manometer and air flow alarms/indicators inoperative, fan not running at rated speed,
- Specification — Incorrect filters, type of use, preventative maintenance, booth clearance time displayed,
- Incorrect use — Booth not being maintained at negative pressure.

E.5.4 Hybrid spray booth

Periodicity: 14 monthly — includes booth clearance time and leakage test.

Substances: Paint and thinner fumes.

Potential hazards: Explosive atmosphere.



Test methodology: The approach to testing these hybrid structure booths should, as far as possible, be as that adopted for testing the side draught booths. Air velocity measurements should be taken in a plane where the operator works within the booth.

Measurements should be taken across the width of the booth regularly spaced at three heights, with a minimum horizontal spacing of one test point for every meter of booth width. The mean of these measurements should not be less than 0.5m/s with minimum individual measured values of 0.4m/s.

Air sampling: See Appendix D.1

Typical problems:

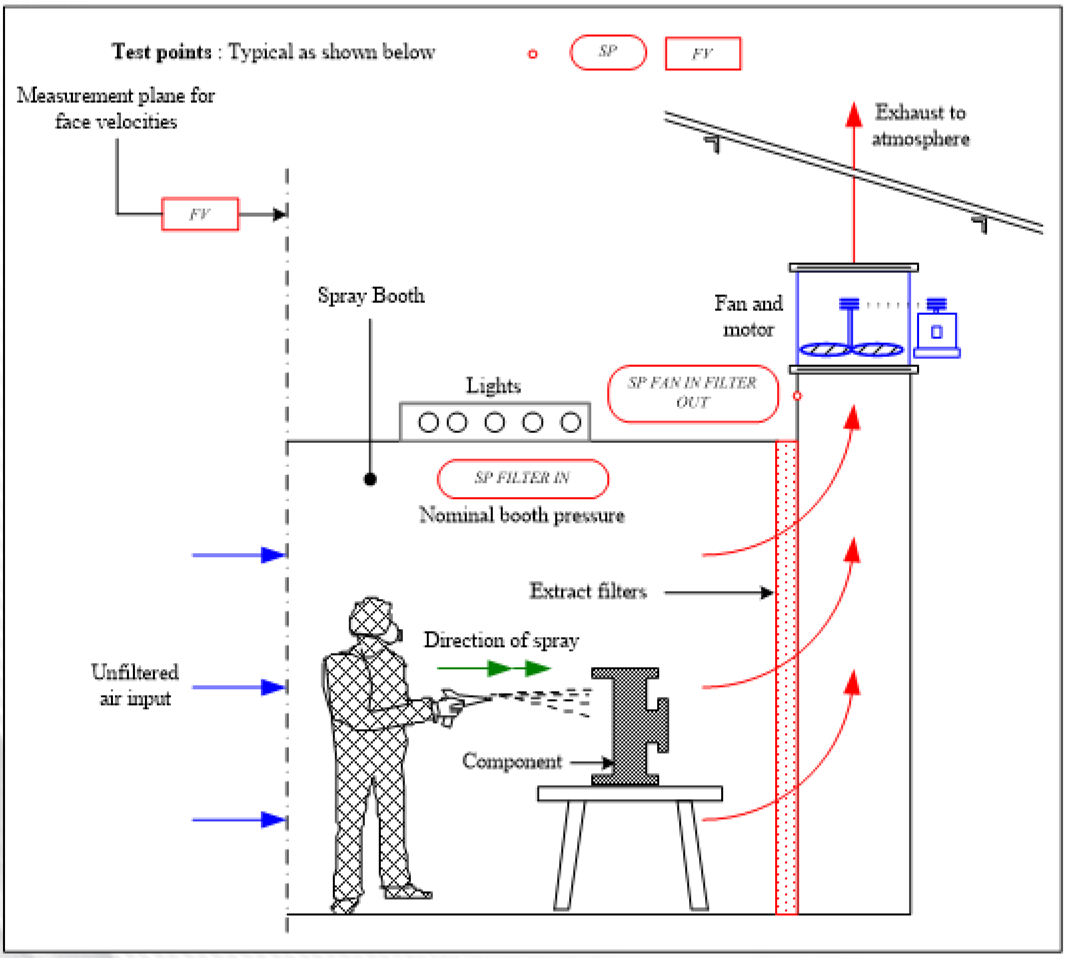
- Congested — Filters,
- Damaged/holed — Enclosure door seals, filters, lights,
- Incorrect operation — Air flow alarms/indicators inoperative, fans not running at rated speed,
- Specification — Incorrect filters, type of use, preventative maintenance, booth clearance time displayed,
- Incorrect use — Booth not being maintained at negative pressure, Directional spraying away from exhaust filters.

E.5.5 Open fronted side draught booth

Periodicity: 14 monthly.

Substances: Paint and thinner fumes.

Potential hazards: Explosive atmosphere.



Test Methodology:

A minimum average air velocity of 0.7 m/s at the front of the booth is recommended. Air speed measurements should be taken across the width of the booth, regularly spaced at three heights with a minimum horizontal spacing of one test point for every metre of booth width.

Where the operator works inside the booth, the plane of the measurement should be where he/she works. The mean should not be less than 0.5m/s with minimum individual measured values of 0.4m/s.

Air sampling: See Appendix D.1.

Typical problems:

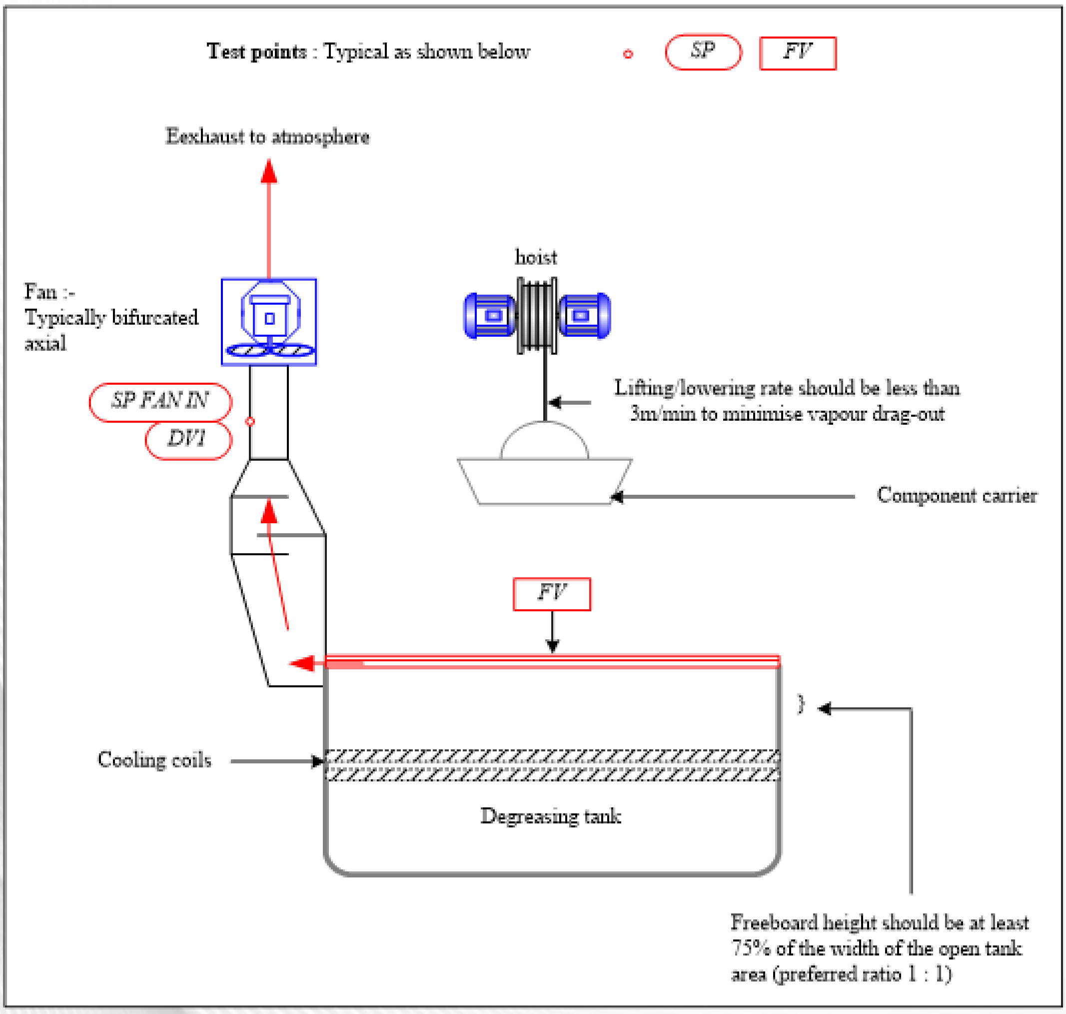
- Congested — Filters,
- Damaged/holed — Filters, lights,
- Incorrect operation — Fan not running at rated speed,
- Specification — Incorrect filters, type of use, preventative maintenance,
- Incorrect use — Directional spraying away from exhaust filters, influence from doors, windows, air handling plant.

E.6. Dipping — Sample process guide

E.6.1 Vapour degreasing, cold cleaning

Periodicity: 14 Monthly.

Substance: Trichloroethylene, 1-1-1 trichloroethane etc.



Air sampling: **See Appendix D.1.**

Typical problems:

- Congested — Extract slots,
- Damaged/holed — Extract slots, fan inlet ducting, exhaust stack, tank cover,
- Incorrect operation — Fan rotation (centrifugal), hoist motor speed,

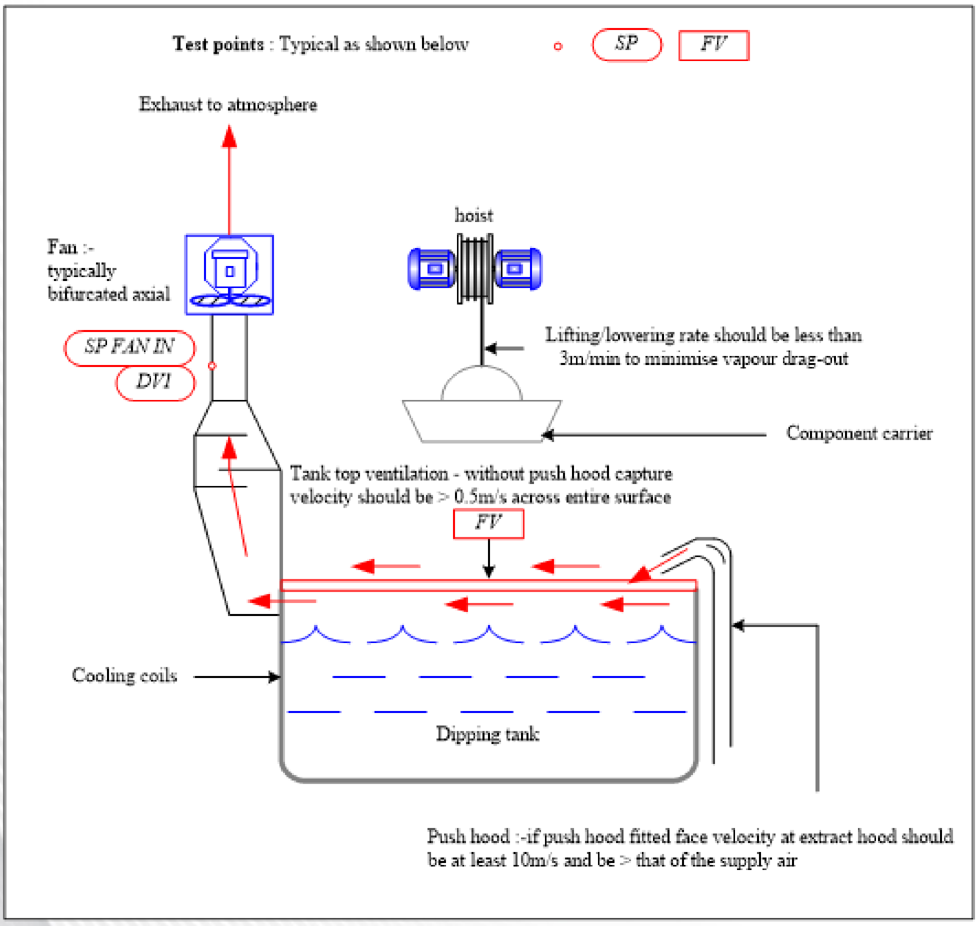
- Specification — Type of use, preventative maintenance,
- Incorrect use— Influence from doors, windows, air handling plant,

E.6.2 Pickling, electroplating, cold cleaning etc

Periodicity: 14 monthly.

Substances: Acid vapours, alkalis mists, metal vapours, etc.

Potential hazards: Corrosive.



Air sampling: See Appendix D.1

Typical problems:

- Congested — Fan or tank inlet grille,
- Damaged/holed — Tank, fan inlet ducting, exhaust stack, push hood,
- Incorrect operation — Hoist motor speed,
- Specification — Type of use, preventative maintenance,
- Incorrect use — Influence from doors, windows, air handling plant.

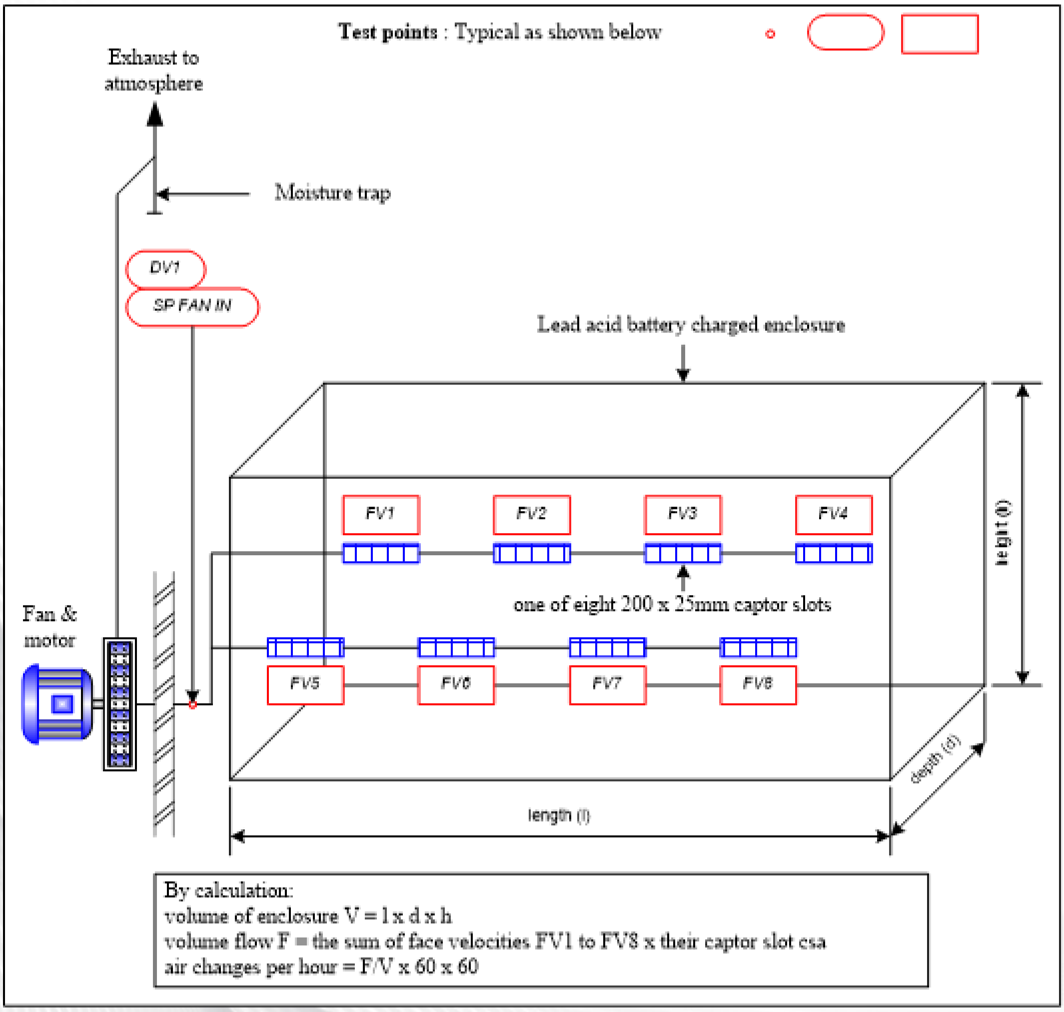
E.7. Dilution ventilation — Sample process guide

E.7.1 Battery charging

Periodicity: 14 monthly.

Substances: Acid and alkaline fume/vapours/gases.

Potential hazards: Corrosive and explosive atmosphere.



Air sampling: See Appendix D.1.

Typical problems:

- Congested — Fan inlet, captor slots/grilles,
- Damaged/holed — Fan enclosure, fan inlet ducting, exhaust stack, captors,

- Incorrect operation — Fan rotation. Calculated air changes are assuming perfect volume mixing, this may not be the case, enclosures with pits, direction changes and pitched roofs will contain pockets of substance vapour or fume requiring a greater clearance time. Where this is the case a generated smoke test should be considered and the clearance time displayed,

- Specification — Type of use, preventative maintenance,

- Incorrect use — Charging acid and alkaline cells in same enclosure, charging cells without exhaust fan running (charger and fan drive should be interlocked).