The Chartered Society for Worker Health Protection

Northern Ireland Regional Meeting

4th April 2016

Practical LEV Testing

Presented by Louise Wood

Airducts Design Limited & Airducts Engineering Ltd

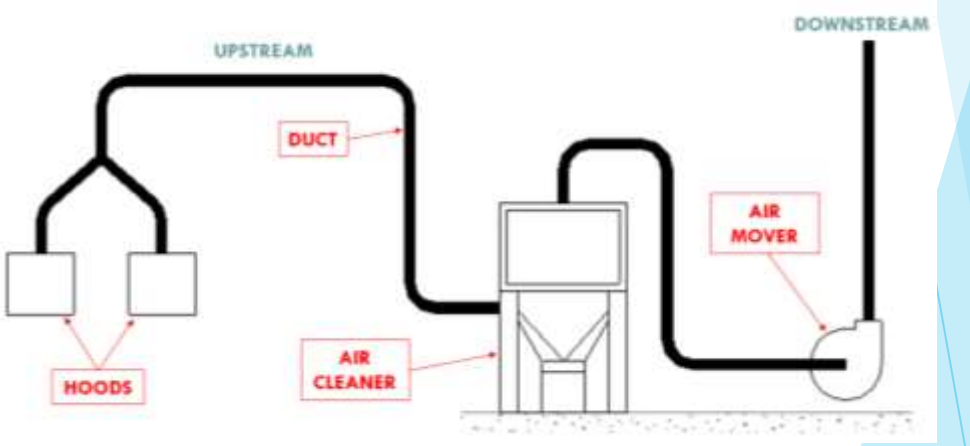
www.Airducts-ltd.co.uk

What is LEV?

LEV is the acronym for Local Exhaust Ventilation.

It is an engineering control system to reduce exposures to airborne contaminates such as dust, mist, fume, vapour or gas in a workplace. Systems may include:

- Wood Dust Extraction systems.
- Welding Fume Extraction systems.
- Spray booths.
- Laboratory Fume cupboards.
- Soldering fume extraction systems.
- Integral grinding dust extraction.
- Any other systems for which the control of hazardous substances (e.g. dust, fume, gases or vapours) relying upon their removal by exhaust ventilation.



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Why do we test LEV Systems?

To comply with regulation 9 of CoSHH and HSG258.

The COSHH Regulations 2002:

- **Reg 6 - Suitable & sufficient risk assessments.**
  This is assessing the risks and deciding if the controls are adequate.
- **Reg 7 - Hierarchy of control.**
  This is a step by step guide to follow to help ensure that exposure to harmful contaminates is prevented or adequately controlled.
- **Reg 8 - Use of Control Measures.**
  The Employer must ensure that the Employee is using the controls correctly. The Employee also has a duty to use the control measures correctly and report any defects.
- **Reg 9 - Maintenance, Examination & Testing of Controls.**
  All Local Exhaust Systems (LEV) should be thoroughly examined & tested at least once in a period 14 months by a competent person. This is to ensure that your system remains effective at control.

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Why do we test LEV Systems?

To comply with regulation 9 of CoSHH and HSG258.

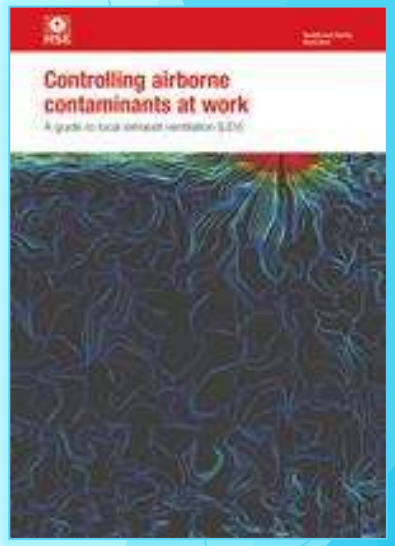
HSG 258:

This guidance describes the principles and good practice of deciding on, designing, commissioning and testing cost-effective LEV.

The guidance is written for suppliers of LEV goods and services, but will also be helpful for employers and managers in medium-sized businesses, and trade union and employee safety representatives. All of these groups need to work together to provide, maintain and use effective LEV and to reduce exposure from inhalation of hazardous substances.

The book contains information about: the roles and legal responsibilities of suppliers, and of their clients as employers; competence; principles of good design practice for LEV hoods and their classification; ducts, air movers, air cleaners; and system documentation.

Available for free download: http://www.hse.gov.uk/pubns/books/hsg258.htm



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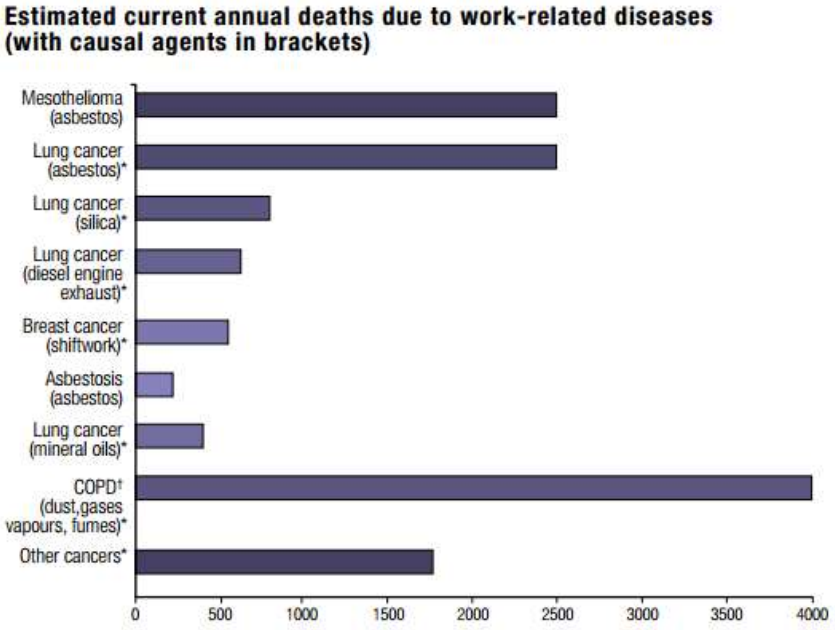
HSE Statistics 2014/2015

UK Fatal diseases

- Around **13,000 deaths** each year from work-related lung disease and cancer are estimated to be attributed to past exposure, primarily to chemical and dust at work.



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The consequence of exposure to harmful dusts and fumes

Respiratory diseases tend to be **long latency** and as a result the consequences of exposure are not appreciated. When symptoms do appear they are **irreversible.**

Respiratory diseases include:

- Chronic obstructive pulmonary disease (COPD).
- Occupational asthma.
- Pneumonia/pneumoconiosis.
- Mesothelioma.
- Silicosis.
- Cancer.

With the right controls applied and maintained respiratory disease is completely preventable!

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What is it like living with occupational respiratory disease?

Simply awful. It limits the ability to undertake everyday tasks such as:

- Cooking & cleaning.
- Walking up stairs.
- Walking to the shop.
- Having a kick about with the kids.

It affects the whole family!

The HSE have interviews with two gentlemen living with respiratory diseases. To find out more visit www.hse.gov.uk and search for:

- Phil the Welder.
- Terry the stoneworker.

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LEV Industry Problems

- Not enough awareness on the health effects.
- Current guidance focussed on ideal text book systems.
- Too much emphasis on assessing the hoods in a TExT.
- Systems often not in operation at the time of test. Need to ensure hoods are suitable for the process.
- Not enough understanding of LEV Design to assess.
- Inappropriate off the shelf systems applied.
- Incompetence.
- Inadequate maintenance & management.

We need to encourage strong relationships between Engineers and Occupational Hygienists. Each have strengths that can compliment each other.

ASSESSMENT

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Different types of assessments

There are 3 types of assessments listed in HSG258:

- **Commissioning**
  This is a Thorough Examination and Test of a system only you are benchmarking the results recorded against the design criteria. Normally undertaken when a system is first installed or when there have been any alterations to the system.
- **LEV Test**
  This is a Thorough Examination and Test (TExT) of a system. We benchmark the results recorded against Commissioning or previous TExT data. This is a mandatory statutory assessment undertaken at least once in a period of 14 months.
- **Weekly checks**
  These are visual assessments to ensure that the LEV System is in good condition.

Tools of the trade

Some of the tools required for conducting an LEV test:

- Diameter tape
- Tape measure
- Electrical screwdrivers & pliers
- Drill & bits
- Volt stick
- Clamp meter for reading Amps
- Noise meter
- Infrared thermometer
- Labels
- Ladders

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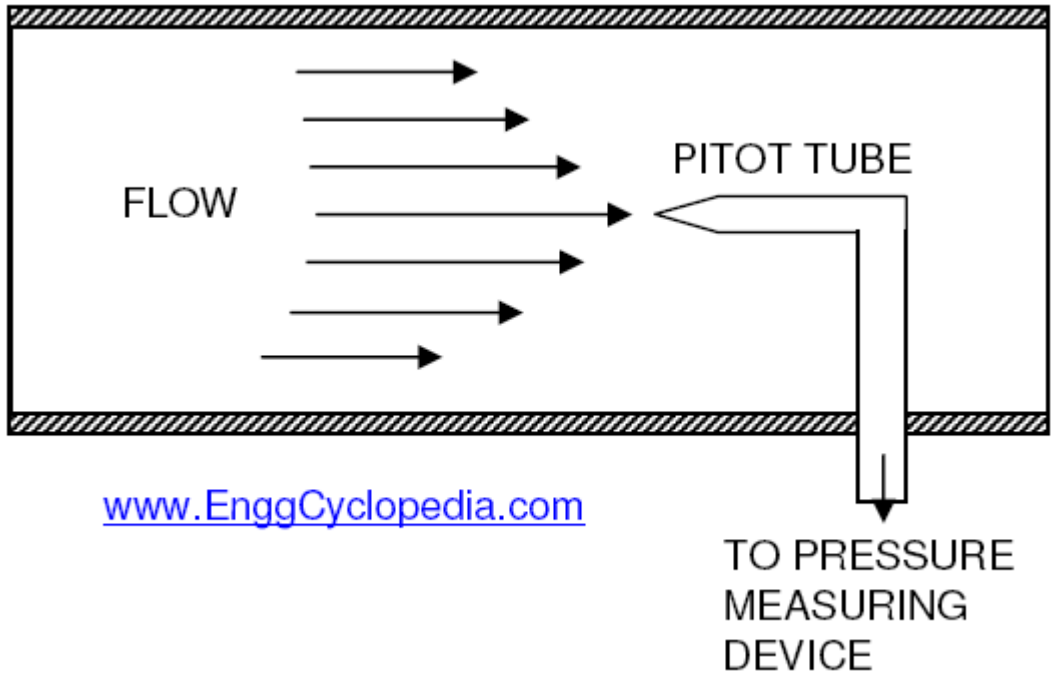
It's not what you do but the way that you do it & that’s what get’s results

- For maximum accuracy we must use our equipment properly.



It's not what you do but the way that you do it & that’s what get’s results

- For maximum accuracy in the results it is recommended to take several velocity readings across a traverse plane inside the duct or across the face of a hood and then average them.

Diagram looking inside round duct showing 2 traverse lines and the several points you should take readings.

For Duct:

- Wherever possible take readings **4-6 diameters away from turbulence** (i.e. bend, fan outlet).
- For ducts 150mmØ and smaller – at least **<u>6 traverse points</u>** should be taken.
- For ducts larger than150mmØ – at least **<u>10 traverse points</u>** should be taken.

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Qualitative Assessment

Select a qualitative assessment that is suitable for the process.

- Tyndall lamp for dust, fume & vapours when the system is in operation.
- Tracer smoke for vapour/fumes. Normally used when the system is not in operation but need a visual indicator to performance.

Tracer Smoke

Tracer smoke is used to visualise the airflow.

Tyndall lamp

For illuminating the invisible respirable dusts.

How to use a dust lamp

290 When using a dust lamp, do the following:

- Examine the work process. Where are the contaminant sources?
- Use the dust lamp on a tripod to light the potential source.
- Run the process.
- Stand off the axis of the light beam. Shielding your eyes from the lamp with an opaque barrier, look up the light beam. View the forward scattering of light from the particle cloud.

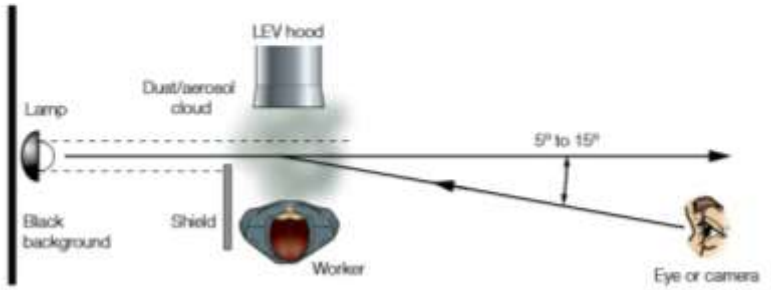

Figure 44 How to use a dust lamp

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Invisible contaminants

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HOODS

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Are the operators using the controls?

- If the system is in operation then observe the operators.
- If the system is not in use then look for visual clues such as fugitive emissions or hoods placed out of the way.

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How can we encourage operators to use capture hoods correctly?

In this example the operator was using the hood but was not positioning the hood quite close enough.

We can label the hood with the results of our hood assessment.

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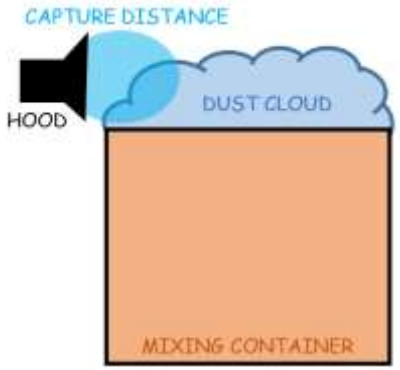
Ensure the hood encompasses the working area?



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Ensure the hood encompasses the working area?

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Are all sources of dust generation being controlled?

Flour is poured into the top of the mechanical sieve.

Sieved flour pours into a container outside the hood.

Disposable RPE make great hats

This is the container that the sieved powders were filled into. The operator pushes the container to this point releasing powders during transportation. At this point he then adds more dry powder from a blue tub creating a large visible plume of dust. Another plume of dust is created when he puts his empty blue tub back down on the pallet.

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Too much of a good thing is bad for you

- Excessive filter media installed. Completely blocking airflow.

Filter not sealed correctly

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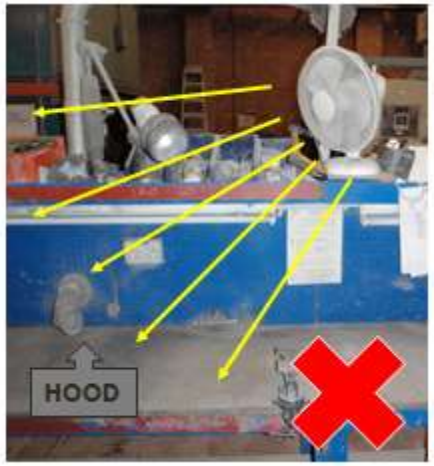
Draughts are the enemy

Fans used for thermal comfort/damaged roofs/walls/doorways can all cause draughts that will have a negative effect on the hoods performance. This will result in exposure of dusts/fumes to the operator.



We can use tracer smoke to detect draughts by releasing a gentle puff outside of the hood.

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What about sources that are not part of the LEV Systems you are testing?

If you see any sources of dust/fume generation that are uncontrolled then there is an ethical & professional duty to raise the issue with your contact.

This is a buttercream mixer.

The operators pour sugar, butter & other additives into the vessel. The mixer mechanically mixes the ingredients but during operation it releases a lot of fine dust into the workplace air.

This was a separate process happening in the same room as the LEV we were testing.

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DUCT

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Duct design

Ductwork should be of simple design with smooth sweeping bends to minimise turbulence within the duct. Duct joining angles should be in the direction of the airflow.

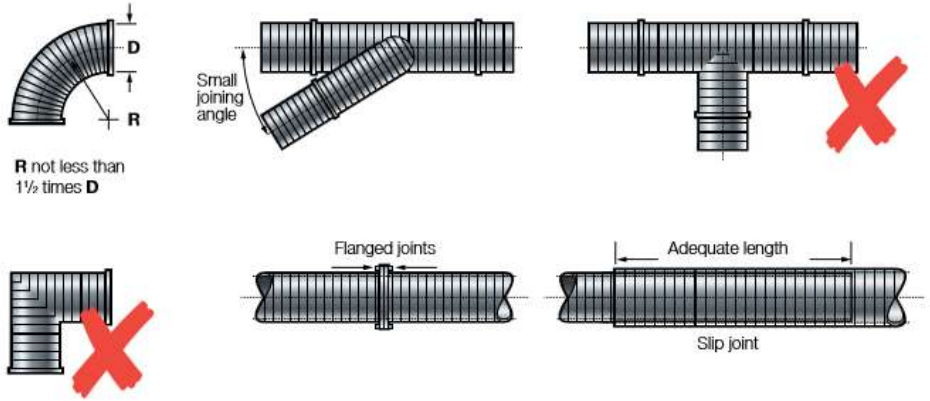
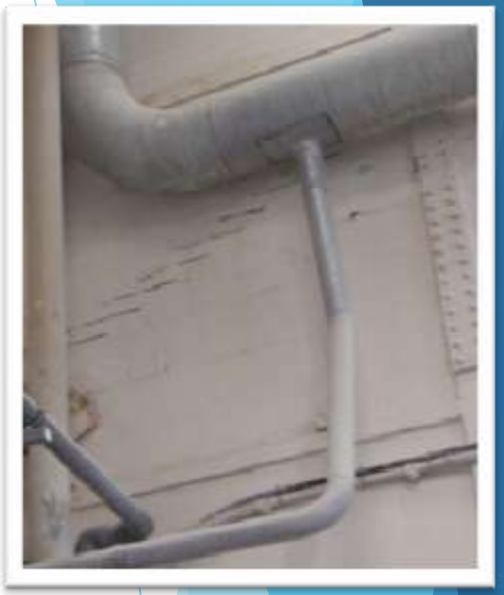


Figure 33 Bends, junctions and joints in ducting



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Material matters

Ensure the duct material is suitable for the substance that the airstream is handling.

For example:

- Plastic duct is not suitable for handling wood dust. Plastic creates static which could be a source of ignition for the highly flammable and explosive wood dust.
- Mild steel and galvanised steel is not suitable for use with Hydrochloric Acid (HCL) or Ozone as they rot away the material.
- Check there is no damage to the duct which could affect the airflow.
- Check there are no air leaks.
- Check the thickness of the duct. Light gauge duct is unsuitable for high abrasive airstreams.

HCL Rotting

Excessive oxidisation caused by Ozone produced by Aluminium welding.

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Blocking hell

It is important to check our duct for settlement. Blocked ductwork is a serious issue and can cause ill-health/injury and even death because:

- Hoods could fail.
- Duct can collapse.
- Flammable hazard.
- Explosion hazard.



If there are access doors then use them to assess inside the duct.


No access doors? Then use a screwdriver to tap the duct. There are distinct tone differences between empty duct and duct with settlement in.

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FANS

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The fan

The fan is designed to move air within the LEV system by creating differences in pressure. The duct before and after the fan should be well designed and smooth to minimise turbulence and swirling which increase system losses. Any bends should ideally be positioned at least 5 duct diameters downstream of the fan.

Tarp caused fan to overheat and was removed due to potential fire hazard

Bend on top of fan outlet

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Suitability

Make sure the fan is suitable for the airstream it is handling. If the airstream is highly flammable then it will require a specialised fan.

We can reference the info from the fan rating plate on the internet to find out if the fan is suitable for flammable airstreams.

Fans with the motors out of the airstream include:

- Bifurcated fan.
- Belt driven fans.

Check that the guards are in place.

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One direction

Three phase centrifugal fans running in reverse will still suck but a reduced rate!

- Always check the fan rotation at every assessment. Why? Because the client may have had electrical work between assessments which could alter the fan rotation!!

How to check rotation:

- Locate the fan (may need to remove access doors) and quickly switch the unit on and off. Let the impeller slow down and watch the motor. As it slows down the direction of rotation will become apparent.
- The fan or motor will normally have a sticker indicating the rotation direction.

Going round in circles?

RUN AND STANDBY FANS

- Always check that there are adequate dampers to stop the air simply circulating around the run and standby fan rather than exhausting through the stack. Without dampers this has a negative effect on the hoods performance:

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FILTER UNITS

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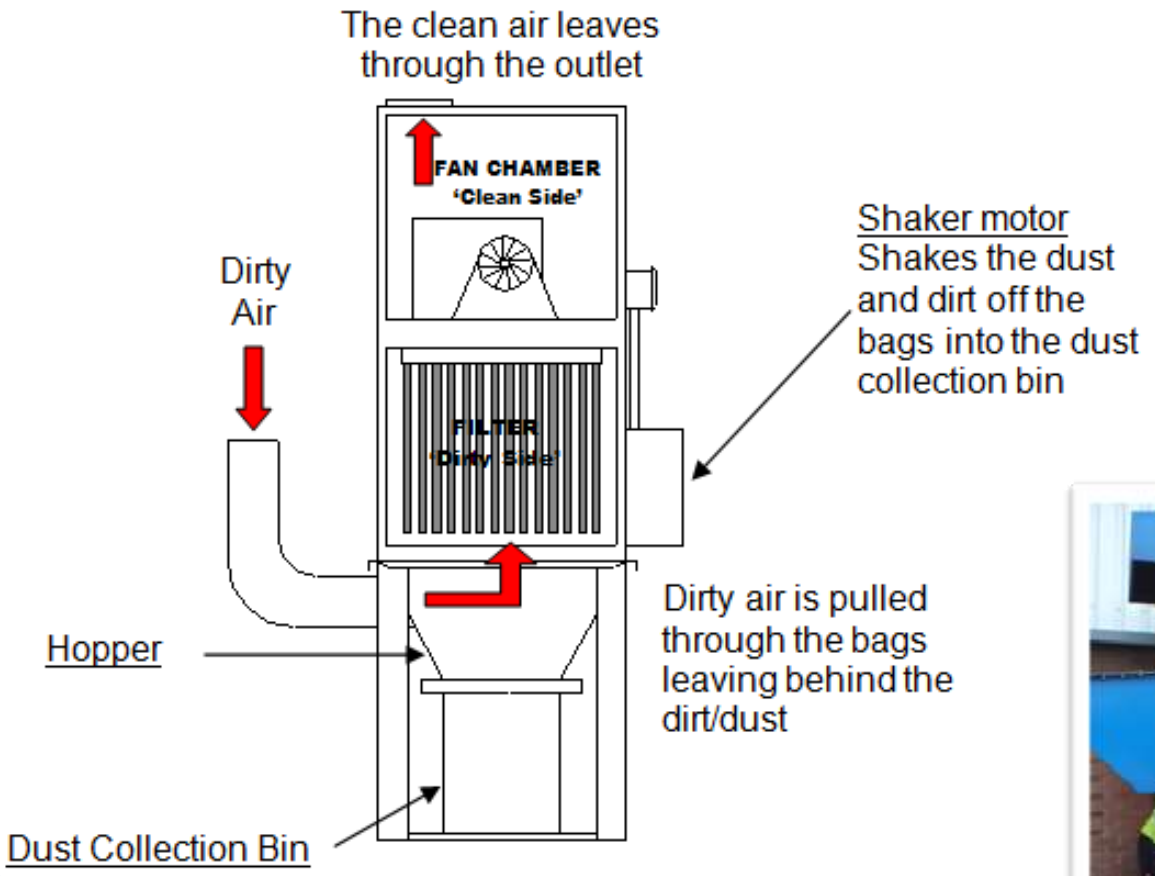
Dust Filter units

Some of the common types of dust filter units:

- **Mechanical Shake** filters are fabric multi-pocket bags which are attached to a shaker mechanism. These units are designed for short duration and remove the build up of waste by mechanically shaking the bags.
- **Reverse Jet** filters are either fabric socks or cartridges. These are commonly found where there is constant production. A pulse of compressed air is released into the filters which releases any waste build up on the filters.
- **Open bag** filters are as the name suggests, where the filter media is open. Commonly seen in woodworking industry. They are often incorrectly applied and don't have a good enough filtration grade for the finer dusts.
- **Wet dust collectors** are filter units with turns inside. When the unit is in operation water in the hopper is drawn into the unit and violently thrown about the turns capturing the dust. This then settles as a sludge at the base of the unit. Ideal for highly explosive dusts.

Mechanical Shake Dust Filter units



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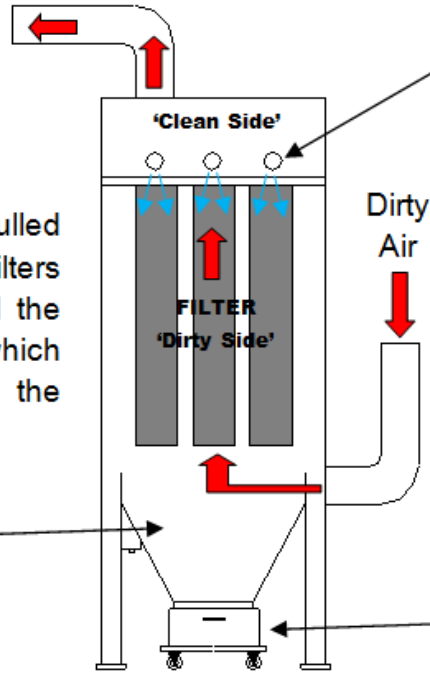
Reverse Jet Dust Filter units

The clean air is pulled through the system via a fan on this side of the filter.



Compressed air
Sends a pulse of air reverse to the airflow onto the filters. The air pressure effectively pushes off the build-up of dirt on the filters.

Dirty air is pulled through the filters leaving behind the dirt/dust which builds up on the filters

Dirty Air

Hopper

Dust Collection Bin

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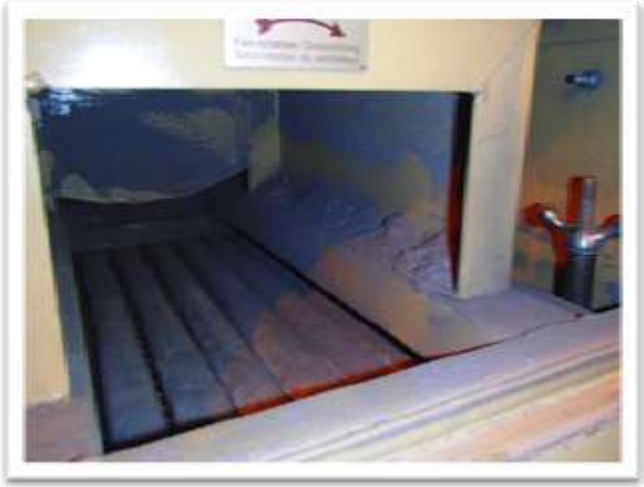
Filters located in the workplace

- Watch the filter unit shake down as poor door seals may be a source of dust exposure!
- Is there secondary filtration?
- Condition of filters. Clean side is normally a good clue.
- Seals?



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A bit of cake is good!

Your filters should have a nice even coating of dust/filter cake. Like us, filters perform better with a bit of cake!

But too much filter cake can block the filters and make your hoods fail. As part of an LEV assessment we need to ensure the cleaning mechanism is working correctly.

- Mechanical shake.
  - Are all the bags aligned on the shaker bar?
  - Moving parts connected and operating correctly?
  - Fatigue cracks?
- Reverse Jet.
  - Pulse frequency – over pulsing waste of money & wears valve springs & media quicker.
  - Are all rows of cartridges clean?

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Vent to a safe place

Explosions are rare but do happen! As part of our assessment we should check that the dust filters explosion panel vents to a safe place and are not restricted.

The following is taken from **HSG103**:

> *"Where you site explosion vents is important because, if they are close to a wall or other combustion products they make the vent ineffective. Normally you should leave a minimum space of 1 panel diameter or diagonal between a vent panel and an obstruction. A larger distance will be needed to prevent damage to masonry walls from the pressure wave"*

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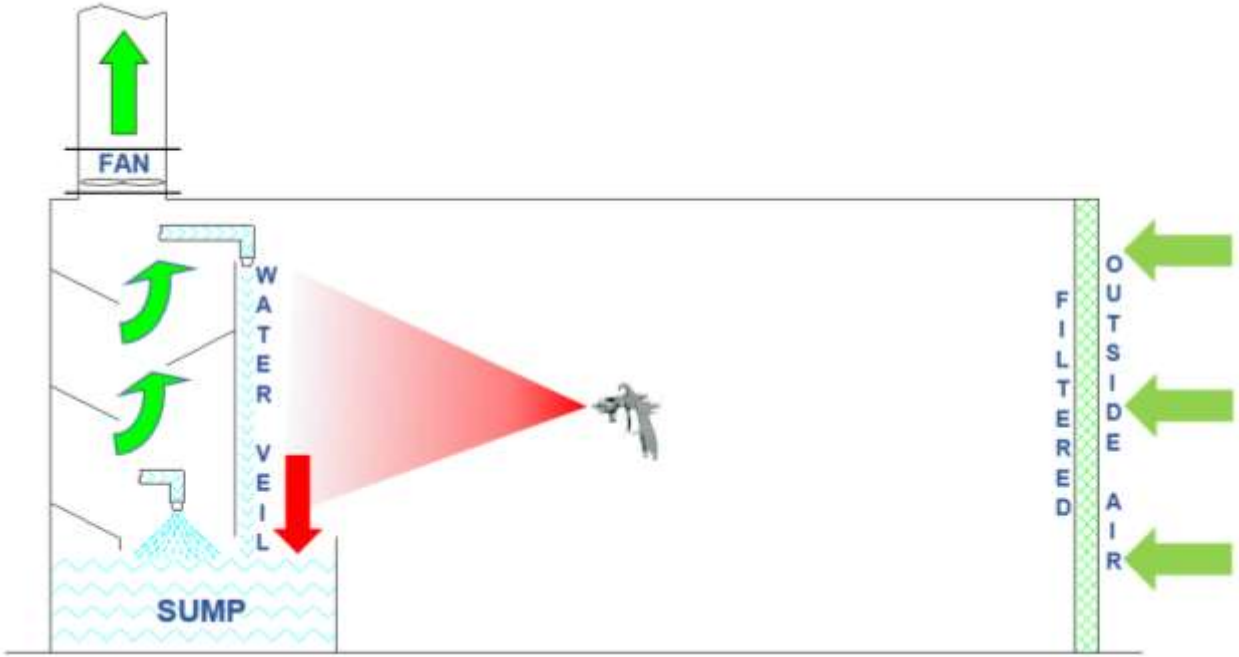
Water Veil spray booth

Same principle as a spray paint booth with dry media only water is the filter media. Mainly found in powder coating processes.

Directional fume and particles hit the recirculating water veil where the water quenches the particulate pulling it down into the sump.

The air is then drawn up behind the water veil where it is sprayed again.

The air is then thrown around a series of plenums to remove any moisture. The filtered air then leaves through a fan and discharge stack.



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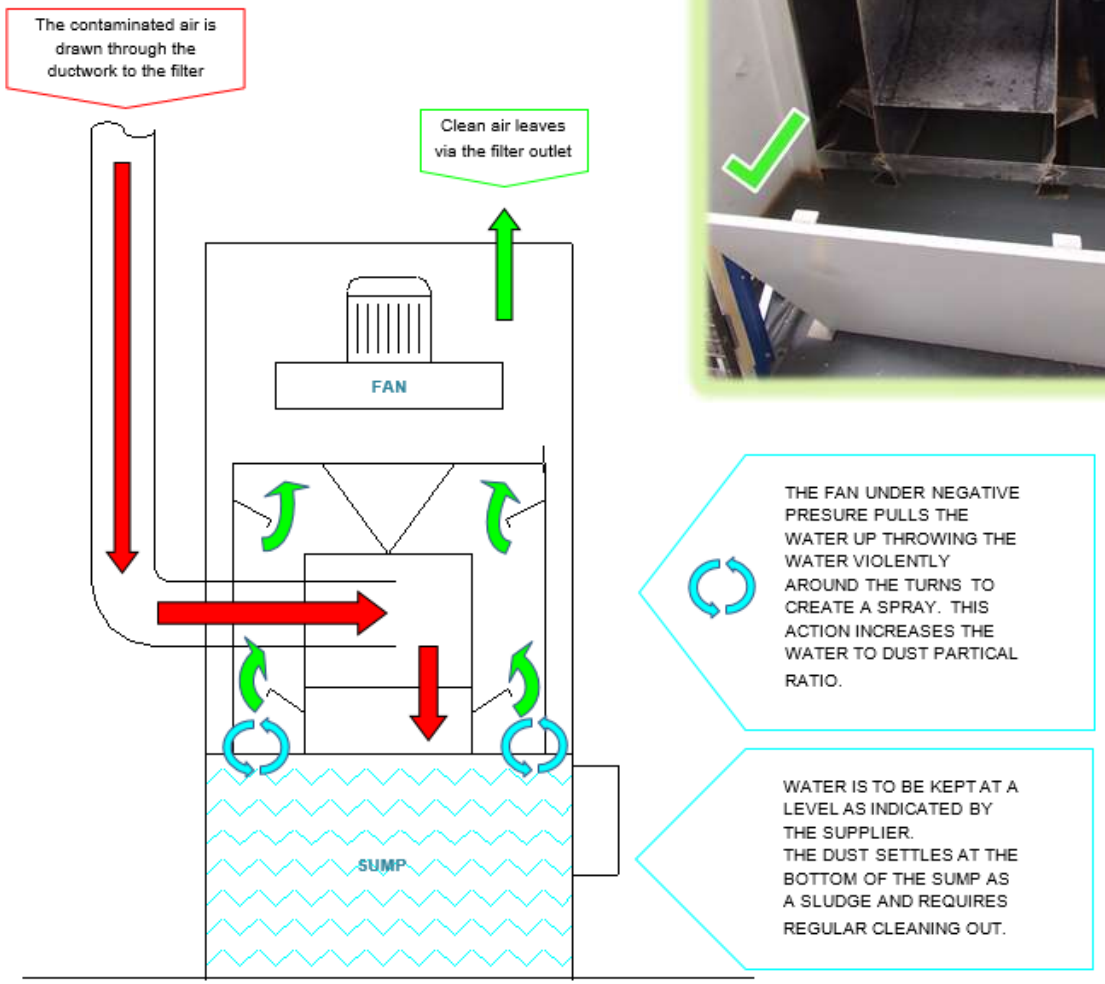
Wet filters



THE FAN UNDER NEGATIVE PRESURE PULLS THE WATER UP THROWING THE WATER VIOLENTLY AROUND THE TURNS TO CREATE A SPRAY. THIS ACTION INCREASES THE WATER TO DUST PARTICAL RATIO.

WATER IS TO BE KEPT AT A LEVEL AS INDICATED BY THE SUPPLIER.
THE DUST SETTLES AT THE BOTTOM OF THE SUMP AS A SLUDGE AND REQUIRES REGULAR CLEANING OUT.

Photos of some wet collectors. Left; Photo inside a collector with the door removed:

The fan sucks up the water and throws it over the turns within increasing water to dust particle ratio. This washes the particles into the hopper where they collect in the bottom as a sludge.

We need to make sure that there isn't excessive build up of sludge inside the unit that can affect the performance.

Also checking for signs of corrosion. Water can react with some substances to create explosive gases.

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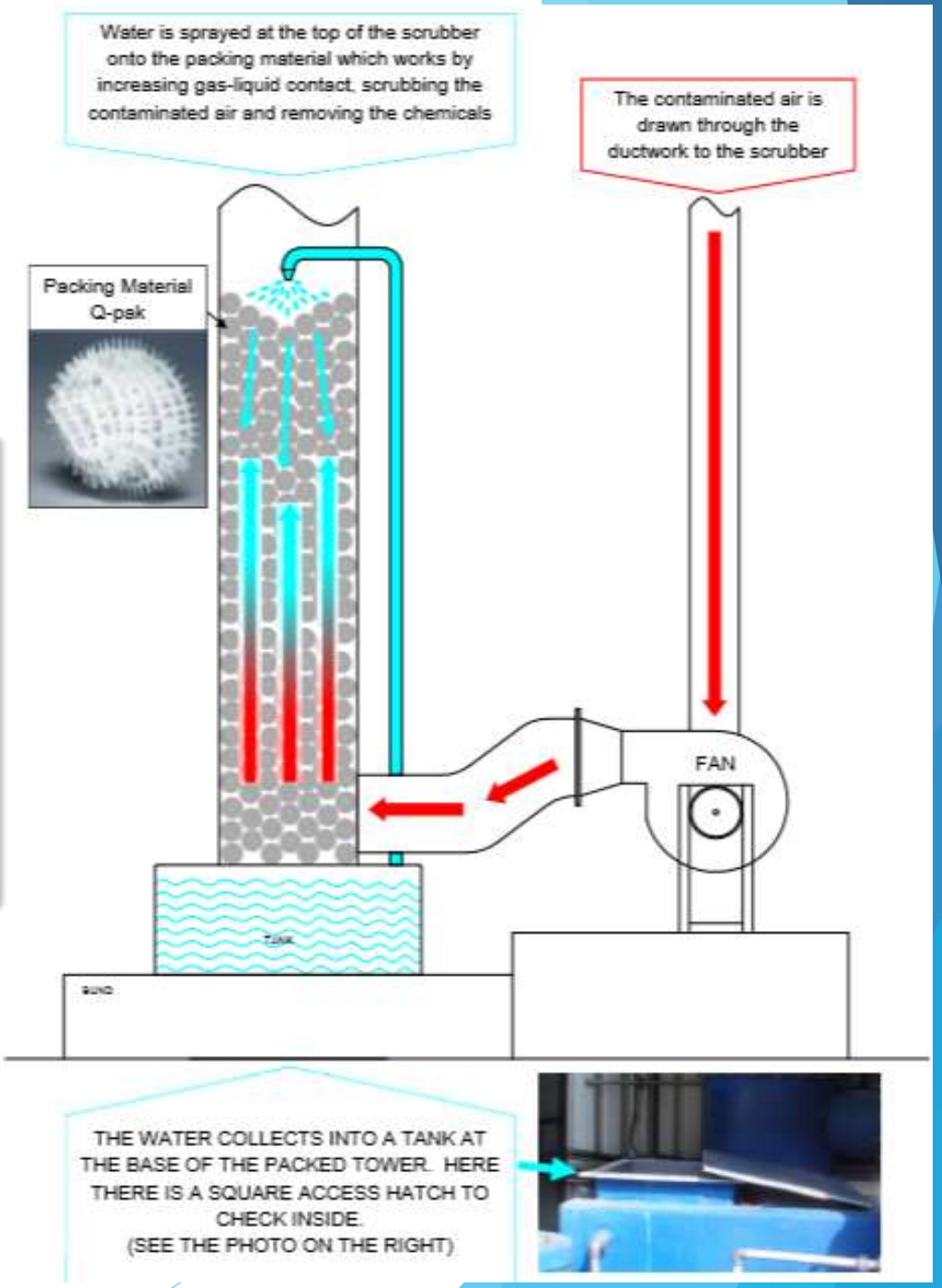
Packed Tower Scrubbers

Typical anatomy of a Packed tower scrubber:



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DISCHARGE

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Out of sight out of mind

Ensure the stack has sufficient support.

- It will either be braced under the roof via buildings structural steels.
- Supported above the roof using guywire supports.
- Has there been roof work since the last assessment? Have the roofers removed the supports?

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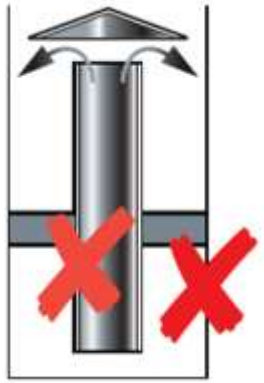
Out of Sight out of mind

Spray painting exhaust



(a) Never use this type of discharge

Welding fume exhaust stack gone.

Air input fan

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Look the last LEV Test said it was ok!

Note date google maps recorded this image!

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Risk of re-entry?

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Risk of re-entry?

Exhaust terminates under the roofline

Windows that get opened particularly in the summer.

Open mesh bottom

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Risk of re-entry?

Hose exhausts harmful fumes onto busy walkway at low level

Windows that get opened particularly in the summer.

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DISCUSSION
HOW DO WE TEST THESE LEV SYSTEMS?

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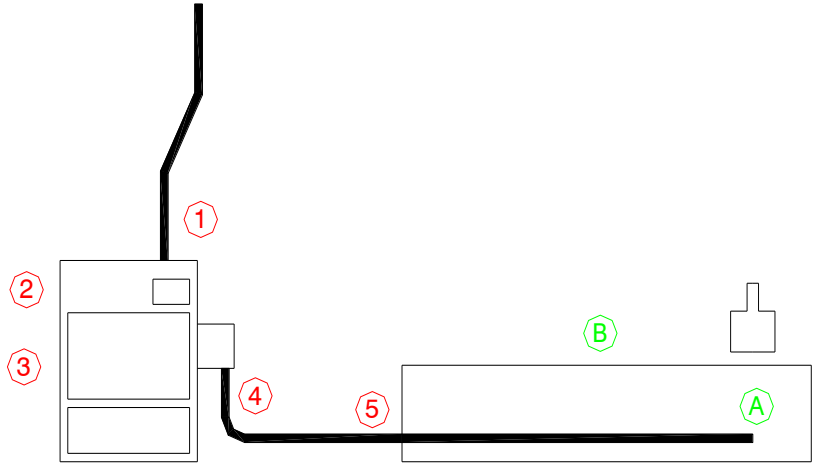
CNC Plasma beds



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Ducted Fume Cupboards

NOTE:

British standards BS EN 14175-4:2004 apply when testing fume cupboards!

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Small shot blast enclosures

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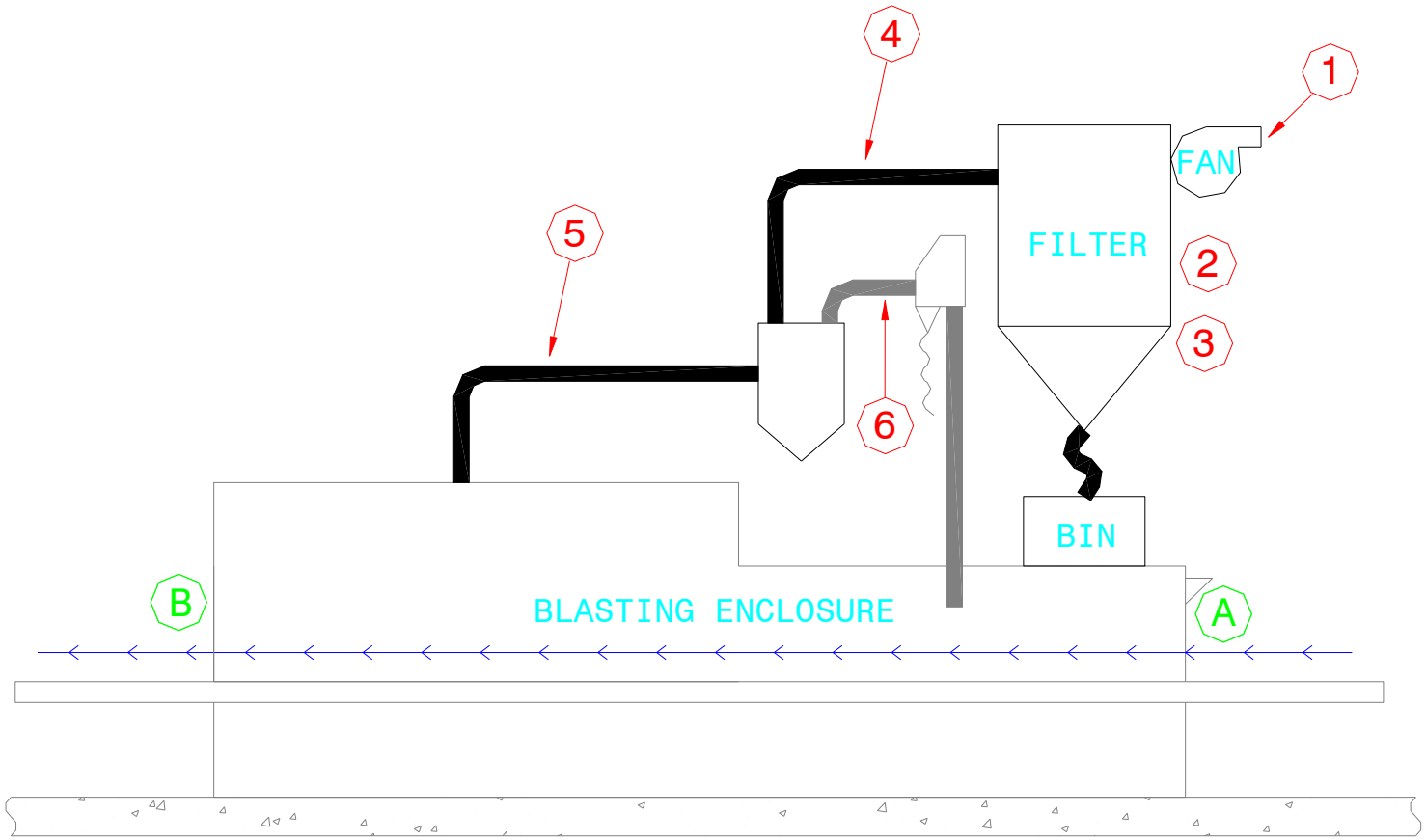
Shot blast enclosures (Large)



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Portable Welding Fume (Inconel welding)

MSDS sheet tells us that the Inconel composition will include

- Aluminium
- Chromium
- Colbalt
- Copper
- Iron
- Magnese
- Molybdenum
- Nickle

It gives us WEL's as well as symptoms as a result of exposure to fumes which include siderosis which appears to be a benign pneumoconiosis, sensitisation, magnese poisoning, metal fume fever, neurological problems and even cancer.

Is it suitable for the fume it is controlling?

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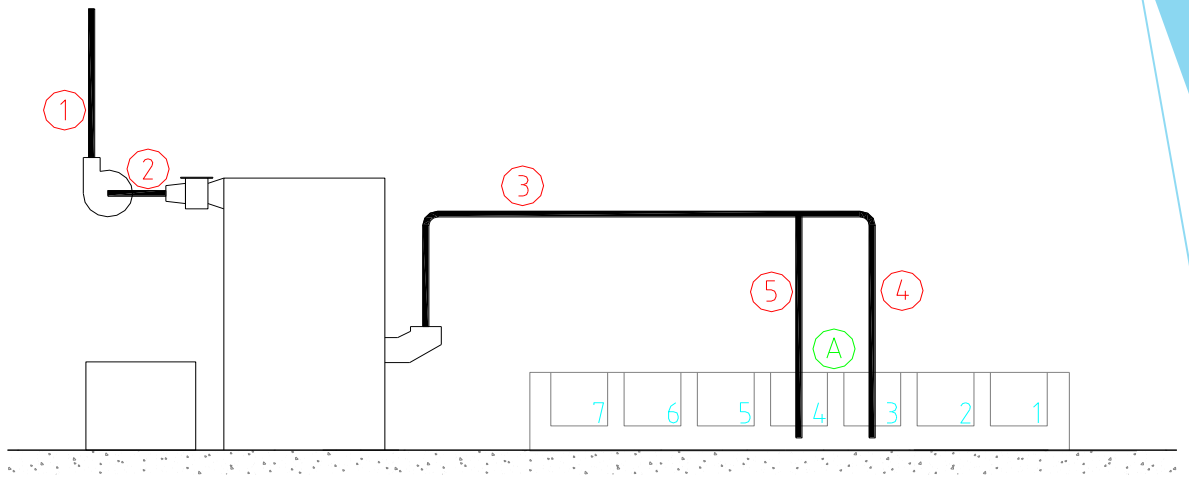
Dip Lines



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Battery fume extraction

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Professional Development

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Professional development

This regional meeting has given just a small taster of LEV Testing.

In order to enhance your professional development then the BOHS offer the following proficiency certificates including:

- P601 - Thorough Examination & Test of LEV Systems.
- P602 - Design of LEV Systems.
- P603 - Control of hazardous substances – PPE.
- P604 - Performance evaluation and management of LEV systems.
- W201 - Basic principles of occupational hygiene.

If you have attained the suite of PCert's there is the option of applying for:

- CoC Control – Certificate of competence in Control

Support and Information

LEV Central

www.levcentral.com

Health and Safety Executive (HSE)

www.hse.gov.uk

BOHS

www.bohs.org

LinkedIn has many active groups such as:

BOHS / LEVCentral etc.

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Thank you

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