Managing the health risks of welding

Welding fume is a varying mixture of airborne gases and very fine particles that is formed as a by-product of welding. It is created by welding carbon or stainless steels, and it was internationally classified as possibly carcinogenic to humans. Stainless steel welding poses serious health risks, and its welding fume both a carcinogen and asthmagen. In 2017 the International Agency for Research on Cancer published evidence that all welding fume is potentially cancer inducing in humans.

Under the UK's Control of Substances Hazardous to Health (COSHH) Regulations, exposure to all carcinogens, asthmagens and mutagens must be reduced As Low As Reasonably Practicable, or "ALARP". This Technical Note explains what employers need to do to protect workers from the hazards posed by welding fume, advice on where to obtain competent expert advice on extract ventilation systems and gives links to further guidance from the HSE.

This advice is relevant to both new and existing systems.

So, what are the other engineering or LEV controls available?

Welding Fume LEV Buying Options

There are multiple options available when it comes to the control of welding fumes using Local Exhaust Ventilation or LEV systems. This document explores some of the pro's and con's of each type of system.

COSHH states that the employer MUST consider using engineering controls for example extraction systems, prior to using PPE and can only use PPE in conjunction with other controls.

What is welding fume?

Welding fume is a mixture of very fine metallic particulate and various gases.
Stainless steel welding has always been seen as a serious health concern and a known carcinogen and asthmagen. In 2019 the International Agency for Research on Cancer and published in their Monograph V118 WELDING, MOLYBDENUM TRIOXIDE, AND INDIUM TIN OXIDE, that ALL welding fume is to be recognised as a cancer inducing substance in humans.

Under the UK's COSHH Regulations, ALL carcinogens, asthmgens and mutagens MUST be reduced to As Low As Reasonably Practicable or ALARP.

So, what are the other engineering or LEV controls available?

Movable Capture Hoods

Description:

This is the most common form of LEV control sold in the UK.
This is a movable hood that has a hood on the end of an articulated flexible arm. Normally bolted to a wall or stanchion, these are readily available in lengths between 2m and 8m in length.

Flexible-arm extraction can be seen as a procedural control measure, as it relies so heavily on the user constantly moving it into the correct position. In the hierarchy of controls (COSHH Reg. 7), procedural control is just above the last resort, PPE including RPE!

Procedural changes are the weakest of the preventative and control measures (elimination, substitution, process change and engineered controls being much stronger solutions, as they don't rely on the operator).

As welding fume is a carcinogen and arms are not a reliable form of control and relies on the user to correctly adjust, there should be personal air sampling program to establish the effectiveness of the extraction system.

Flexible arms come in two distinct sizes, 150mm/160mm diameter or a 200mm diameter.

The larger arm will move a larger air volume and thus provide a higher level of control and enable the weld to worked further away from the face of the hood.

Typical capture distance (i.e. the effective distance from the face of the hood) is equal to the diameter of the hood. The effective capture distance should be clearly shown on the hood to inform users of its limitations.

Research shows that round or square hoods fitted with a flange are more effective than oval or rectangular shaped hoods.

Capture velocity required to control the fume is between 0.5m/sec and 1m/sec. You should always look to use the higher of these two values to give improved levels of control.
Duct velocity should be >10m/sec.

The flexible arm hood is very unlikely to control emissions from associated grinding applications.

Pros:

- Ease of use
- Variety of different sizes – useful for bench work or working on large components
- Good for small / local welds
- Typically low capital cost
- Can be portable / mobile

Cons:

- Level of control achieved (typically 1/10th reduction of hazardous substance)
- Capture zone within which welding must take place
- Will not control exposure to grinding dust
- Requires high level of user input – open to human error
- Not good for long or seam welds
- Easily damaged – high level of maintenance
- Not effective in draughty environments (i.e. open doors or moving vehicles)

On-tool extraction

Description:

The extraction system is attached directly to the tool and draws the contaminant though the tool directly at the source.

Pros:

- Depending on the type of weld being worked can be up to 90% effective
- Captures the contaminant at source
- Integrated with tool – pull torch trigger extraction comes on
- Less affected by draughts
- Good on large structures - can be portable / mobile
- Can be very effective on controlling grinding dust (from 110mm diameter grinders)
- Can be used for clean-up / vacuum

Cons:

- Does not capture 100%. Can be very poor levels of control on certain types of weld
- Can make torches heavy but new technology is improving this all the time
- Can remove shielding gasses if set up incorrectly
- Will not capture fume from welds once welder has moved on – high residual fume
- High kW rating of fan – potentially expensive running cost
- High capital cost

Downflow benches

Description:

Air flow is pulled down through a table or bench and is taken away.

Sometimes the contaminant can be filtered and the air flow recirculated back into the room or it can be ducted to atmosphere.

Typical down flow velocity at the face of the bench is 2.5m/sec.
Duct velocities 10m/sec if welding only, 20m/sec if used for welding and grinding.

Pros:

- Very good levels of control of the hazardous substance (typical reduction factor 1/400th)
- Easy to use – minimal human input
- Good for grinding and gas burning
- Control levels can be improved in draughty areas by fitting side shields
- Range of sizes available
- Bench can be fitted with jigs or vices

Cons:

- Fixed location
- Not good on large components
- Can remove a lot of air from workshop
- Potentially high capital costs especially when filtering grinding dust

Welding booths

Description:

The welding is carried out in a fixed location either on a bench or in a booth.

A booth is a 5-sided enclosure with an opening on one face.

The air flow across the open face needs to be in the range of 0.5m/sec and 1m/sec. You should always look to use the higher of these two values to give improved levels of control.

Pros:

- Minimal human input
- Very good level of control. Reduction factor up to 1/500th
- Can be good for control of grinding dust

Cons:

- Restrictive – fixed location
- Useless if work taken out of enclosure
- If a walk-in booth the welder will still require suitable RPE

Welding towers, push pull, roof fans & air cleaners

Description:

This is not LEV since it is not local. Must be used in conjunction with other engineering controls such as those listed above.

Pros:

- Continuous running will continuously filter and clean the air or just extract the air, in turn diluting the contaminant over time

Cons:

- Continuous running – high running cost & maintenance requirement
- Does not control the fumes at source
- Does not control grinding dust
- High capital cost
- Welding towers are large units will take up floor space
- Roof fans will need to extract large air volumes and will increase heating costs
- Potential increase in noise in workplace

Summary

All forms of engineering controls and LEV have issues. There is no one solution fits all applications. To achieve adequate control of the hazardous substance you will almost certainly require a combination of systems as a solution.

Generally the more you can enclose or the more air you move the higher level of control you will achieve however the more restrictive the solution is.

When looking for your solution you MUST consider ALL sources of exposure. Typically in a fabrication workshop this will be from activities such as welding, grinding, cleaning and opening doors (draughts / wind disturbing dust).

The lower the control achieved the more there will be to clean up. Sweeping or compressed air is not an option!

Captial cost can appear high however these systems should be viewed as a long-term investment with typical pay back periods of 5 to 10 years. Solutions to capital cost such as leasing are widely available.

Do not forget what ever system is adopted, user training and on-going maintenance is vital for the continued effectiveness of the system and the safe wellbeing of ALL persons who access these areas.

Who can help?

Should you require any help or guidance in considering the control measures you currently have in place or in implementing training plans, new or modifications to systems or testing and servicing existing systems, ILEVE can direct you to industry leading qualified engineers who can provide you with clear competent advice and what is the best and most effective approach for your business.

Ask to see the ILEVE Competency Card, our engineers are always happy to show it!

They will also be able to put you in contact with air monitoring assessors who will be able to independently verify the exposure levels before and after you implement any control solutions, helping you keep your employees safe from harm.

For further information or to find a LEV Consultant contact ileve@cibse.org or visit our website at:

www.ileve.org.uk

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