

# Health & Safety: Weld Fume Control & Extraction

For many gas and arc welding processes, the fume concentration in the immediate vicinity of the weld can be well above the recommended exposure limit. The amount of fume generated is determined primarily by welding process, consumable and procedure. However, a number of aspects can influence the degree to which welders are exposed to fume, including welding position, location, type of workplace, and exposure duration. As welders using the same process may be exposed to different levels of fume, the risks for each job should be assessed individually.

## Weld Fume Generation

Welding fumes are generated from:

- The filler metal and flux
- The parent plate or its contaminants, or
- From the action of ultraviolet radiation from a welding arc on the surrounding air

Particulates are produced only in the immediate vicinity of the heat source. They are largely confined to the plume of heated gases, which rises from the weld zone. This plume is often visible to an observer, but not to the welder.

The gaseous decomposition products of contaminants remaining on the workpiece are more widely distributed, and are generated from the heated portions of the workpiece.

Ozone is generated in a volume of the atmosphere beyond the arc zone. It is not concentrated in the plume to the same extent as particulates. Most welding processes with a visible arc generate levels of ozone, which place the welder at some risk of exceeding exposure standards unless controls are implemented.

Oxides of nitrogen may be generated by reactions in the air near the welding zone. However, they are unlikely to be generated at levels approaching exposure standards. Oxides of nitrogen are usually only an issue in plasma cutting processes that use nitrogen additions in shielding gas.



A number of factors influence welding fume exposure, and should be controlled to ensure the safety of the welder and all workers.

## Weld Fume Influences

### Welding Position

The welding position (flat, vertical, horizontal or overhead) and proximity of the welder to the fume plume affect exposure. As the welder naturally bends over the workpiece, the flat position induces the highest level of fume in the breathing zone. The welder should adopt a working position which ensures that his head is away from the plume.

### Location and Type of Workplace

Welding in a large workshop, or outdoors, prevents build-up of fume and gases. However, in a small workshop, fume will not be readily dispersed and the welder may be subjected to a higher than average

exposure. Working in confined spaces, requires an efficient, monitored, ventilation system to control exposure, and ensure there is no depletion of oxygen in the atmosphere.

### Exposure Duration

Exposure is usually intermittent, particularly during arcing. There should be relatively little exposure between arcing periods but this may be influenced by the presence of other welders, effectiveness of control measures and general ventilation. Furthermore, as the work pattern (arcing time and down time) vary from day-to-day, average exposure may often only be assessed by frequent sampling.

## Weld Fume Control Measures

### Modification of Processes for Less Fume

Shielding gas can be modified to reduce fume by changing the species in the gas mixture, their balance, or by introducing reactive components. Significant reductions in fume generation rates can also be obtained by reducing the energy of the arc. Unfortunately, the size of these effects cannot be reliably predicted from current knowledge, and these fume control methods must be supported by measurements of workers fume exposure.

### Isolate Workers from the Hazardous Fume

Automation of processes allows workers to be remote from fume sources. General ventilation of the workplace must then be adequate to prevent an excessive increase of background levels of fume.

### Engineering Control Methods

There are two types of engineering control methods: **Breathing Zone Ventilation (BZV)**: pollutants are prevented from entering the operators breathing zone by sweeping them away with a cross draft of air. A minimum cross draft away from the operators breathing zone of 0.5m/s will ensure protection against particulate and ozone. A pedestal fan is generally adequate for this purpose. All workers in must be positioned to avoid fume from other operators, and an adequate level of general ventilation must be provided. Inexpensive instruments for the measurement of air velocity are available from suppliers of fume extractors, air conditioning and laboratory equipment.

**Local Exhaust Ventilation (LEV)**: captures fume at its source before it enters the operators breathing zone or the workshop atmosphere. LEV should be positioned to capture the plume in which the particulates are concentrated. A minimum capture velocity of 0.5m/s, measured at the fume source is required for protection of the welder from particulate and ozone near the arc.

High air velocities at the fume extractor lead to greater efficiency of capture of fumes. Most gas shielded welding processes can tolerate air velocities around the weld zone of about 2 m/s. Where adequate welds cannot be made due to disturbance of the gas shield by fume extraction, the shielding gas flow rate may be increased, or the process may be changed, or the welder may use personal protective equipment (PPE).

Exhaust fume from LEV equipment should be adequately filtered, including for ozone, if it is to be discharged. If it is to be discharged outside the workplace, the relevant environmental regulations should be followed, and it should be isolated from any air intake to the workplace. Ozone generated between the arc and the operators breathing zone may require additional control measures.

### PPE Control Methods

When deciding on respirators as a control method, consideration must be given to fellow workers who may also be exposed to fume, and any effect on equipment maintenance or performance caused by the fume. Care must be taken regarding hygiene, maintenance and correct facial fit. Respirators must filter both particulates and ozone. For further details, refer to *WTIA Technical Note 7 Health and Safety in Welding*.

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