Fume Control Strategies

How to make your welding operation safer

As technologies improve to identify and understand the airborne contaminants in our workplaces, regulations are changing that require fume concentration reduction. Compensation costs are increasing, resulting in increased enforcement. Overall understanding and awareness of the nature of workplace air is increasing with everyone. As the need to improve air quality by reducing fume becomes more apparent, the question of how to get there becomes more urgent.

Separating the worker from the contaminant is the ultimate goal. The traditional approach is to exhaust dusty air outside the shop. This is the simplest method, but it can be inefficient, expensive in colder climates and can interfere with the welding process.

A good solution must address the following:

- Identify the problem
- Protect the worker
- Maintain the quality of the work
- Minimize the environmental impact
- Remain cost effective.

What produces fume? Welding fume is only one part of the contaminants created in the welding process. Industrial gases that shield the weld puddle can displace oxygen, toxic by-products from burning surface treatments such as oil, paints, cleaners and surface treatments offer specific hazard potential. Welding is a very hot process that vapourizes some metal. The hot vapour rises from the weld puddle to coalesce to fume in the cooler air above. The oxygen rich air stream oxidizes the fume, which quickly rises upward.

Testing confirms that consumables form the majority of fume, with a small amount produced from base material and surface contaminants.

Consult Material Safety Data sheets for advice on constituents of consumables, and base material constituents. Contaminants from surface materials such as paint, oils and cleaning solvents can be much more harmful than anything in the metal fume. Galvanizing and plating improves corrosion resistance, but can increase the amount of contaminants created by the weld. Where practicable, galvanize the finished product rather than welding the galvanized product.

To minimize worker exposure, first minimize the fume. In order:

i. Eliminate fume-generating processes
ii. Re-engineer the workplace to minimize and isolate fume generation
iii. Change to lower fume alternatives
iv. Capture fume at source before it reaches the worker
v. Personal protective equipment at the worker
vi. Clean the air to reduce ambient hazards
vii. Exchange stale air with fresh.

Hotter processes generally generate more fumes. Modern testing labs report Fume Generation Rates (FGR) as a percentage of the welding wire consumed. The more welding done, the more fume created. By minimizing unnecessary welding, fume generation is reduced.

IMPROVE WELD DESIGN

Over welding is typical. Increasing a weld fillet from 3/16 in. to ¼ in. results in a 79 per cent increase in metal deposition. Increasing, from ¼ in. to 5/16 in. fillet results in a 56 per cent increase in metal deposition. By fine-tuning the weld design and weld process, fume generation can be minimized and costs can be kept in line.

Get the weld right the first time. By increasing efficiency, rework and r e-welding can be reduced or eliminated. Maintain the best weld; avoid porosity, warping, and over weld.

UPGRADE THE WELDING PROCESS

Many process changes can improve efficiencies and reduce fume generation. Moving from straight MIG to a pulse process or Surface Tension Transfer can reduce fume generation by half.

Stick and Flux Core welding typically creates 2.5 to 4 times more smoke than MIG welding. Sub-Arc will produce 10 to 50 times less smoke than MIG welding.

Changing from CO_2 to an Argon blend can reduce fume generation by half again.

AUTOMATE THE WELDING PROCESS

Automation has a number of benefits. A well-designed automated system allows strict control of the weld design, eliminating over weld, and maximizing welding rates and overall production. It can often be isolated from the worker, reducing exposure to fume, heat, and arc flash. Isolating the welding process allows much better capture of fume.


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CAPTURE FUME AT SOURCE

When process changes minimiz exposure to fume, capture what remains where it is produced. Never blow the smoke away. This affects the shielding gas and pollutes the larger work environment.

Use vacuum capture instead. Air should move from the worker, past the weld zone and to the capture point. A well-placed source capture arm captures all fume generated by the welding process. Arms capture smoke from a defined area, and then easily move to cover other areas. Good workstation design will minimize handling of the capture arm, allowing workers to concentrate on production.

Very long welds, larger than 12 in. to 18 in. are better serviced by back draft capture or source capture welding guns. Back draft extraction can be very effective for longer welds, but requires a large quantity of air to be effective.

Source capture welding guns use integrated extraction on the welding torch. A high vacuum source can capture the smoke rising from the weld


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with a minimum amount of air. Take care to avoid disturbing the shielding gas, and it is sometimes necessary to increase the flow of shielding gas to compensate. Source capture guns are 75 to 95 per cent effective when used for flat or fillet welds. They are far less effective in tacking, out of position welding and in any application where the shielding gas can blow the smoke away from the capture nozzle. A secondary source of general ventilation is often required with source capture guns.

Overhead hoods can isolate a specific workstation, but are counter productive for welders within the work envelope. While effectively using natural air currents from the hot weld puddle upwards, fume is encouraged to rise through the breathing zone of the welder by the movement of air up towards the hood. Hoods are effective for capture in automated and semi-automated systems where the worker is isolated from the process by barriers or distance.

When a work process cannot use source capture, fume builds up in the working environment. Use respirators to protect workers specifically exposed to fume and gases from the welding process.

An efficient filtered general ventilation system, while not protecting the worker at source, can maintain a clean and safe work area by keeping the concentration of fume in air below 1 mg/m^3.

Tips to improve the system:

- Simplify the application. The simpler the system is to use the easier it is to enforce. The fewer choices the worker has to make, the less chance they will forget or refuse.
- Always use respirators to protect the worker when isolation and capture at source is not practical.
- Maintain an effective filter. A good filtration system will capture the fume and dust, returning clean air typically capturing greater than 99 per cent of the contaminants.
- Automate the capture and filtration system. Filtration can make up the largest cost of a fume capture system, but there are ways to minimize costs, while maintaining efficiencies. By using sensors to detect the welding process, automated dampers open when needed and close when there is no need. By automating the collection system, welders can concentrate on the work, rather than the secondary processes.
- Minimize noise. Fan silencers and smart controls reduce noise and power consumption, while increasing filter life and efficiency.
- Bring in the fresh air. Filtration can eliminate the dust and particulate, but does nothing about industrial gas buildup and oxygen depletion. Air exchange remains very important.
- Make use of available expertise. Work with a knowledgeable welding professional who understands all aspects of the welding process. Those who regularly work in a variety of environments have experience with more and different solutions. Many suppliers and distributors will offer free support and advice to their loyal customers. They have access to all the latest technology and research on causes and solutions for problems and concerns that can arise. **CM**

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