

Example of a well-designed fume extraction system using high-efficiency filtration, a custom ducting layout and curtains to help contain contaminants within the process area.

THE “INS” AND “OUTS” OF WELDING FUME REMOVAL

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When cleaning the air of welding fumes, captured fumes must be exhausted either inside or out – with the chosen location dictating the overall approach to compliance

A Farr Gold Series dust collector with top-mount motor fan and silencer reduced floor space requirements and installation costs at the General Sheet Metal Works welding shop. The system is quiet, powerful and flexible.



It's a well-known premise that keeping welding-shop air as clean as possible helps to safeguard people, property and productivity. But in cleaning the air of welding fumes, you either have to (A) recirculate the cleaned air inside the facility or (B) exhaust the air outside. If you choose option A, you'll need to keep below OSHA thresholds for various types of metal contaminants generated by welding processes. If you opt for B, i.e., exhausting the air outdoors, you will be subject to EPA emission requirements instead.

For business owners with welding operations, this article will provide general guidelines on what you need to know for both approaches. We will also review the hazardous health effects associated with non-compliance.

Keeping indoor air clean

OSHA has established permissible exposure limits (PELs) based on 8-hour time weighted average for hundreds of dusts, including the numerous metals contained in welding fumes. For further information, a good starting point is the OSHA Fact Sheet, "[Controlling Hazardous Fume and Gases during Welding.](#)"

Emissions testing using air sampling techniques is often performed to determine what pollutants are occurring and ensure that a shop's indoor air is in compliance with OSHA regulations. But why is testing so important? Overexposure to weld fumes can cause a wide range of health problems:

- Metal dust particles in welding fumes are an eye irritant and a leading cause of eye injuries in factories.
- Manganese, the primary metal in welding wire, can cause workers to feel exhausted, apathetic, weak or headachy. Chronic overexposure to such fumes leads to a condition known as "manganism," which is characterized by neurological and neurobehavioral health problems.
- Hexavalent chromium or hex chrome is a carcinogenic substance produced during welding or other types of "hot work" on stainless steel and other metals that contain chromium. Hex chrome overexposure can result in short-term upper

respiratory symptoms, eye or skin irritations. Long-term, the greatest health danger associated with hex chrome exposure is lung cancer. Other major health effects include damage to the upper respiratory system and allergic and irritant contact dermatitis. Respiratory tract problems can include inhalation damage to mucus membranes, perforation of septum tissue between the nostrils of the nose and damage to the lungs. In addition, there may be injury to the eyes, skin, liver and kidneys.

- Once in the body, hex chrome typically targets some of the body's organs. A worker exposed to hex chrome may also experience symptoms such as sinus irritation, nosebleeds, stomach and nose ulcers, skin rash, chest tightness, wheezing and shortness of breath. The current OSHA PEL for hex chrome is extremely stringent, at just 0.005 mg/m³ (milligrams per cubic meter) or 5.0 µg/ m³ (micrograms per cubic meter).
- Zinc oxide is a pollutant generated

This weld shop uses a recirculating system that recycles clean air through the workplace downstream of the fume extraction process. It has been independently tested to produce emissions far below OSHA Personal Exposure Limits (PELs) for the metals contained in welding fumes.

by hot work on galvanized steel. Exposure can result in a condition known as “metal fume fever,” a short-term illness in which severe flu-like symptoms occur after a break from work, such as after a weekend or during a vacation. Due to the delayed reaction, it is often confused with regular influenza and many cases go undiagnosed.

- Welding fumes can also cause

headaches. A customer who manages 60 welders reported experiencing daily headaches for years. The problem disappeared upon installing an ambient fume removal system.

Therefore, it’s imperative to know and follow OSHA exposure guidelines for the above metals, particularly where workers are at risk for long-term health effects. But health is not the only concern. Welding fume or “smoke”

consists of hot dust particles that rise to the ceiling. What most people don’t know is that these particles lose their buoyancy when they cool, falling to settle on floors, desks, office furniture and paperwork. And no one wants to work in a dirty shop.

Also, if you haven’t tested your dust for flammability and explosivity, the National Fire Protection Association guidelines call for you to do so. An environmental engineer or your fume collection equipment supplier can connect you

with a lab that specializes in explosion testing.

**Exhausting air outdoors:
What you need to know**

In the past, when weld fumes became excessive, the simple solution was to open the shop door and exhaust the fumes outside. Due to today’s more stringent EPA regulations, that is no longer an option. If fumes are exhausted outdoors, the air is subject to stringent monitoring under the EPA National Emission Standard for Hazardous Air Pollutants (NESHAP) Rule 6x. This rule went into effect in 2011 and is highly applicable to welding shops.

Within this standard are materials that contain 0.1 percent by weight cadmium, chromium, lead, or nickel; or 1.0 percent by weight manganese. Manganese is the material of widest concern to the welding industry, as it is virtually a universal component of welding wire.

Under the new EPA guidelines, if you opt to exhaust the air straight outdoors, you must take an EPA Method 22 Fugitive Emission test. Method 22, which is conducted to provide a visual determination of fugitive emissions



Robotic weld cells are equipped with individual hoods and ducting. A central fume extraction system keeps the area clean while providing the needed mobility.

from material sources, is performed by a trained observer who observes an exhaust stack during a 15-minute timed test. If opacity – defined as the quality of a particle that makes it impervious to light – is observed during 20 percent or more of the test (i.e., 3 minutes), Rule 6x applies. Involvement of an environmental engineering consultant is recommended to conduct the

Method 22 test and provide third-party confirmation of whether a facility is in compliance.

Required actions for compliance

What actions are necessary if Rule 6x applies and a company has failed the Method 22 test?

1. Notify the EPA.
2. "Tier 1" response: Change the process to eliminate the HAP. This might be accomplished by experimenting with different materials and/or different settings to reduce emissions. Whatever changes are made, equipment must always be operated in accordance with the manufacturer's instructions.
3. Conduct another Method 22 Emissions test.
4. "Tier 2" response: If the second test fails, *"Corrective action must take place immediately*

after the failed Method 22 test," per the Federal Register, page 42985, Welding compliance, Tier 2.

The role of cartridge dust and fume collection

Whether you opt to exhaust air indoors or out, one strategy that offers multiple benefits is the use of a dust and fume collector with high efficiency cartridge filtration. Cartridge filtration is identified under Rule 6x as an acceptable control device to eliminate visible emissions and will in many cases be the solution of choice.

A well-designed cartridge system will properly filter welding fumes and other hazardous contaminants, and the filtered air can either be exhausted outside or recirculated back into the facility for significant energy savings. These systems use self-cleaning mechanisms that pulse dirt off the filters, allowing units to run for extended periods between filter change-outs.

There are three general types of cartridge dust and fume collection systems used to clean up welding processes:

1. Source capture systems are





popular for applications involving small parts and fixture welding. They will typically utilize a flexible source capture arm or a complete enclosure around the operation, such as a glass enclosure around a robotic weld cell. This approach is usually limited to smaller envelopes of around a 5-ft. cube or less.

2. Hoods are often utilized if the footprint area is a medium size such as 12 ft. by 20 ft. or less. Curtains or hard walls may be added to the sides to create a booth or enclosure, although the ability to use such barriers may be limited by workspace requirements or the presence of other equipment or processes in the area.

3. Ambient systems that filter all the air in the shop using a central system or multiple smaller collectors are often chosen to serve larger areas because they allow a facility involved in multiple operations to capture all the fumes. Varied welding processes, large parts and stitch welding are examples of operations that are well suited to ambient collection. In winter, heat quickly rises to the


ceiling, resulting in a cold factory floor. Ambient systems provide more even distribution of heated air to create more comfortable factory environments.

If air is exhausted outdoors, as noted previously, the EPA Rule 6x procedures will apply. Under Method 22, the EPA requires ongoing annual compliance that is specific to the operation and is based on the date that the facility originally declares compliance.

One strategy is to install “summer/winter” ducting that allows a shop to filter the air and then exhaust the heated air in summer to the atmosphere. By doing this, a plant can meet OSHA regulations inside the factory as well as EPA discharge regulations. They also pull large volumes of outdoor air into the factory through open doors and windows to make the workplace cooler and more comfortable.

If you opt to recirculate the filtered air instead of exhausting it outside, the indoor air must comply with OSHA PELs. The collector may also require safety monitoring filters (also called after-filters) for added filtration and backup protection.

Air recirculation is the single best way to save energy and maximize return on investment with a dust collector. By recirculating heated air back through the plant instead of venting it outdoors, the cost to replace that conditioned air is eliminated. Facilities in all regions report five- to six-figure annual energy savings with the greatest savings seen in northern climates that experience longer, colder winters. In addition, the U.S. Department of Energy offers public utility-sponsored rebates and incentives for facilities that used recycled heated or air conditioned air.

In summary, a high-efficiency dust and fume collector can greatly reduce or nearly eliminate employee exposure to welding chemicals, resulting in a cleaner and greener work environment that improves comfort and morale, boosts productivity and enhances manufacturing reliability. When you add air recirculation to the equation, you achieve the trifecta of compliance: health, wellness and energy savings. 

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