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# The Complete Guide to Fume Extraction



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## *What you're going to learn!*

This **new and improved** comprehensive E-Book will walk you through all you need to know when considering fume extraction solutions for your welding operation. Inside we cover how your welding operation won't change, your process won't alter, what you need to know when looking at all the different engineered and non-engineered solutions out there, and ultimately how easy and effective it is to introduce smoke extraction to your welding operation.



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# I. Introduction



## About the Author

Etienne Blouin is Regional Sales Manager for ABICOR BINZEL in Canada. Etienne has developed an expertise in smoke extraction and helped ABICOR BINZEL make design improvements in BINZEL's line of fume extraction products, and has helped numerous welding end users in Quebec and other areas of Canada as well as the United States introduce fume extraction to their welding operation.

Etienne studied Physics Engineering at Laval University in Quebec. You can reach Etienne at [eblouin@binzel.ca](mailto:eblouin@binzel.ca).

So you're thinking about making the change to fume extraction? That's great! Your welders will appreciate it, as will the rest of your employees.

Fume extraction – especially at the source – has been one of the more interesting and health conscience welding innovations to come around in quite a while, and with occupational health and safety only becoming more demanding, you might want to get ahead the curve as much as you can while protecting your workforce at the same time.

There's a lot of taboo and bad information about fume extraction. In truth, it's really a lot easier and more cost-effective to introduce fume extraction into your plant than you probably thought. And, what's better, you won't be sacrificing performance to get there. This guide is going to walk you through exactly what you should be aware of and will want to know as you consider fume extraction for your welding operation.

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# II. What's Your Current Welding Operation?



Lots of people worry that integrating fume extraction into their welding operation will negatively impact it, but that's not the case. You will find as you talk with people who use fume extraction in their plant that they haven't had to alter any of their current welding procedures or positions to accommodate it. The things that would impact your decision have more to do with what you weld than how you do it.

## *What Metals are you currently welding? Does it matter?*

The quick answer is that it does matter. All metals release different contaminants into the air as you weld. Metals like stainless steel – which contain steel iron, chrome, nickel, and manganese, are extremely hazardous welding fumes for your welders to breathe in. You may need to get a specialized fume extraction system to safely collect and dispose



### **QUICK TIP!**

**Aluminum**, while considered an irritant, is not currently considered to be a hazardous oxide metal for the welder to breathe in. As such, you can actually use respiratory masks as a sole solution to combat the irritating effects of aluminum for the welder. However, this may not be the case forever as more research into aluminum welding is performed.

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# II. What's Your Current Welding Operation?

of those kinds of contaminants. Anything involving chrome or nickel extraction should be IFA-W3 certified.

Hexavalent chrome particle released when you are valence state. It's less steel and is a cancer. So having traction system that ful elements when above 30% is a very ation.



is the most harmful into the atmosphere welding with a +6 present in all stain-believed cause of a W3 licensed ex-removes these harm-the CrNi content is important consider-

Galvanized steel metal for welders wise a great fit for cause of the harmful alloyed properties

also is a dangerous to inhale and is like-fume extraction be-fumes released. The creating galvanized

steel include iron and steel with a zinc coating. When zinc is welded, it releases zinc oxide fumes, which can cause fume metal fever, damaging the respiratory system. Other metals like lead, which can be used like zinc as a coating on certain metals, can even damage your central nervous system.

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## II. What's Your Current Welding Operation?

Another common welding metal – aluminum – is less a fit for fume extraction than the harder metals out there. Reason being is the process involved. While still creating a lot of smoke at the arc, aluminum oxide fumes are currently considered less hazardous. They are not as toxic as manganese, chromium, or nickel, and the health effects are more irritant in nature than chronic or long term. Plus, the softer property of aluminum demands using Push Pull MIG or TIG torch applications, which cannot accommodate a fume extraction cable or shroud because of the sophisticated wire feeding system. A local exhaust ventilation system, or LEV as they are commonly called, is a better and more recommended solution with aluminum.



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## II. What's Your Current Welding Operation?

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# II. What's Your Current Welding Operation?



*Do I have to drastically change my welding setup to accommodate fume extraction?*

Fortunately for you, the answer is no! You can use the same procedures, protocols, and systems you were previously using in your MIG welding operation while seamlessly integrating fume extraction into it. A general rule to follow is the higher the amperage used, the more you will release fumes into the welder atmosphere. Likewise, some welding processes create more fumes than others.



*Do you have to buy new equipment of some sort?*

Yes, but that doesn't mean the welding parameters or setup is changed. You would have to look into purchasing a vacuum system and a smoke extraction gun if you wanted to make the full commitment with an engineered

### QUICK TIP!

The **American Welding Society** recommends the use of Local Exhaust Ventilation systems as an engineered solution to fume extraction. LEV systems often are examples of the kinds of tradeoffs you make when considering an engineered smoke extraction solution, because they often work better in theory than in practice.

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## II. What's Your Current Welding Operation?

solution, as is typically recommended. But otherwise, there's no change you'll need to make to the way you currently weld other than introducing and using the right equipment for capturing those harmful welding particles.

If fume extraction at the source is not a viable option because you only weld aluminum for example or the investment isn't appropriate, then respiratory masks, LEV systems, and air dilution, or air cleaning systems are other routes to go that can reduce adverse health effects on your welder.



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## II. What's Your Current Welding Operation?

### *Respiratory Masks*



When choosing a respiratory mask, at least in the United States, it must be approved by the National Institute for Occupational Health and Safety (NIOSH). Typically, when dealing with welding fumes, you will consider either half-mask respirators, powered-air-purifying respirators (PAPR), or supplied-air respirators (SAR). When using these types of masks, remember that cartridges and filters have to match the contaminant it is protecting against and be changed periodically. Further, all of the respirator and cartridge selection, medical qualification of welders, welder training and testing, and the maintenance of the respirators must be documented, which can be a time-consuming process for the

Health and Safety Officer.

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Respirators are typically last resort solutions and should be used when engineering control systems – like ventilation control through fume extraction torches and systems, are not feasible. Reason being is while they may be more cost-effective alternatives to combating welding fumes, they are best utilized in combination with an engineered solution and not as the sole means of protection against hazardous fumes. Respirator masks also never actually capture fumes, so they don't protect the workers around the welder who aren't wearing a



respirator mask, nor do they protect the welder when they're done welding and remove the mask.

When using a respiratory mask, consider fit-testing to ensure the snug-gest fit possible, and check to make sure your welder doesn't have any heart or lung conditions that could make wearing a respirator dangerous. OSHA, in fact, has a mandatory medical evaluation

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# II. What's Your Current Welding Operation?



questionnaire for OSHA Respirators, so make sure your welding operators complete this before fitting them with a mask.

## Local Exhaust Ventilation, or LEVs

The American Welding Society classifies a local exhaust ventilation solution as either fixed or movable exhaust hoods and fume extraction arms that are as near to the work as possible. These exhaust hoods are designed to maintain a capture velocity sufficient enough to keep airborne contaminants below the allowed limits.

It should be noted that the American Welding Society actually recommends local exhaust ventilation like fume extraction arms. Fume extraction arms are good examples of an equipment investment tradeoff. While fume extraction arms are effective when they are



### QUICK TIP!

If you are considering fume guns as part of your engineered solution, look carefully at the design of the gun. Make sure it offers the kind of access your welders will demand, and that it's designed to optimally capture smoke during the welding process. Pay special attention to the shape and location of the shrouds.

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## II. What's Your Current Welding Operation?

positioned properly, the fact that the hood has to be close to the weld tends to be problematic in a live fabrication scenario. Another downside of fume extraction arms is that the welder cannot place themselves between the hood and the weld – the hood always is positioned either above the welder or to the side. In theory, exhaust hoods and fume extraction arms are simple and effective to use, but in the real world it's very common to see the welder between the arc and the hood breathing in the fumes before the hood captures it. Why does this happen? Well, when the weld is large or the piece is long, the hood needs to be constantly moved closer the weld where the arc is, and has to be brought into the proper position by the welder. More often than not the welder doesn't stop the weld to continually reposition the arm as the arc moves.



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## II. What's Your Current Welding Operation?

### *Source Capture Air Cleaning*



With source capture air cleaning, the benefits of a local exhaust ventilation solution are achieved with the added benefit of recirculating the air into the work environment. This allows for increased economic benefit of reducing heat loss in the plant while still being able to extract fumes using an LEV-style arm.



The same sort of downsides regarding positioning and practical use in real-world applications apply. Again, the process will rely on the welder either positioning himself optimally to the arm to allow for fumes to be suctioned in, scrubbed, and recirculated, or the welder would need to continually move the arm in the optimal position and he changes positions and angle to ensure proper fume collection. In theory, it is a

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## II. What's Your Current Welding Operation?

great solution, but in practice it can be limited.

### *Is fume extraction that much of a potential health and safety improvement?*

Absolutely. The health improvement using fume extraction is undeniable. One such study from the University of North Carolina found manganese concentrations reduced by up to 50%, so the health im-



provement for the welder is quite significant. Even the most modest of results in this study showed a 20% reduction in manganese concentration. Results are always dependent on the metal involved, the welder position, and the weld in question (whether it's inside, outside, in an enclosed space, etc.).

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## II. What's Your Current Welding Operation?



A separate research study from the Welding Institute tested fume guns and capture efficiencies in fume guns to be as high as 96% after discounting the highest result. This study and test tested a number of different variables – including shielding gas flow, suction flow rate, and weld position, but again even the most modest result of the EWI study showed a capture efficiency of 48% - again when discounting the lowest result.

Think about that much less weld smoke billowing into the plant and especially into the welder's breathing zone. That means far less adverse health effects in the plant, and likely less sick days taken, more productivity, and a better environment.

How much of an improvement will always depend on the equipment investment made as well as the types of metals you weld. It also depends on placement – where the fume



### QUICK TIP!

The **EWI Study** is one of the pre-eminent studies of fume extraction guns ever created. Originally conceived with ship-building in mind, it has become the standard study to date on the effectiveness of fume extraction guns - and the study is over 15 years old! Imagine the fume gun advancements made since.

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## II. What's Your Current Welding Operation?

extraction system is placed relative to where the welder breathes. Often times this is done in error, be it an arm or a fume gun, and fume extraction as a result is not as effective as it otherwise could be because the welder is positioned in the plume.

Fume extraction MIG guns normally work better in such a scenario. They are always at the source of the smoke because they are part of the same tool. It's part of the welding process where the weld is occurring, and is always sitting between the weld and the welder, so it captures more fumes.



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### III. What are the Regulatory Requirements?

*Is there a national law I have to follow? A local?*



In Canada, the current occupational exposure limits are determined by province. So, what the limits are for Ontario may not be what the limits are for Quebec. Looking at Ontario, for example, the Ministry of Labour provides a table to use as a guide for exposure limits, and employers must take reasonable measures to protect workers from these substances. Chromium metal compounds, for instance, have a time-weighted average limit (TWA) of 0.5 mg/m<sup>3</sup>, with that TWA being 8 hours.

OSHA in the United States has several Safety and Health Regulations for welding and cutting when it involves certain metals or gases. For instance, when welding or cutting zinc-bearing base or filler metals with zinc materials, lead base metals, cadmi-

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### III. What are the Regulatory Requirements?

um bearing filler metals, or chromium bearing metals, it is mandatory that a general mechanical or local exhaust ventilation system be used that keeps welding fumes and smoke within safe limits. The American Welding Society likewise has several factors and guidelines that are recommended to be followed when it comes to welders being protected from fumes and ventilation recommendation on the jobsite.

If the metal contains beryllium welding would have to be performed



with both a local fume extraction system and an air-line respirator. OSHA has several guidelines for welding with certain metals and gases, and we highly recommend checking their website to see what fume extraction equipment you may need to have based on what you're welding.

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### III. What are the Regulatory Requirements?

#### *What are some of the generally accepted best practices for fume extraction in a welding environment?*

The American Welding Society recommends at a minimum the use of local exhaust ventilation by the welder. However, if you can extract the welding fume right at the source, it's always better than any other method – including the use of an LEV arm. The intent is to make sure that the manganese, zinc oxide, or hexavalent chromium doesn't spread throughout the plant and become inhaled. Think of it like a virus and you're trying to cover up a cough or a sneeze. If you can control the spread of the smoke right at the arc and get it at the source, it's best.

You also have to protect your welder and non-welders in the general area of the welder. Remember to always wear the proper per-



#### **QUICK TIP!**

**Respiratory masks**, while good stop gap measures, are normally not considered an efficient engineered solution when it comes to manganese or chrome hex weld fume particles. You should also consider that respiratory require welders to complete a physical before being fit for one and cartridges need to be documented at all times.

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### III. What are the Regulatory Requirements?

sonal protective equipment. For instance, wearing a respiratory mask is one way to provide an additional barrier of protection for your welder to make sure he or she isn't ingesting smoke fumes. If you aren't removing the fumes at the source, it's recommended if not required that your welder be wearing some kind of mask to protect against breathing in fumes on top of wearing eye protection.

There are also ventilator cells that filter fresh air into the welding mask to directly provide clean air for the welder to breathe while they work. If you consider this route, keep in mind that there are different masks and filters for different types of metal, similar to the respiratory masks, and that is likely documenting these masks will need to be done by your Health and Safety Officer.

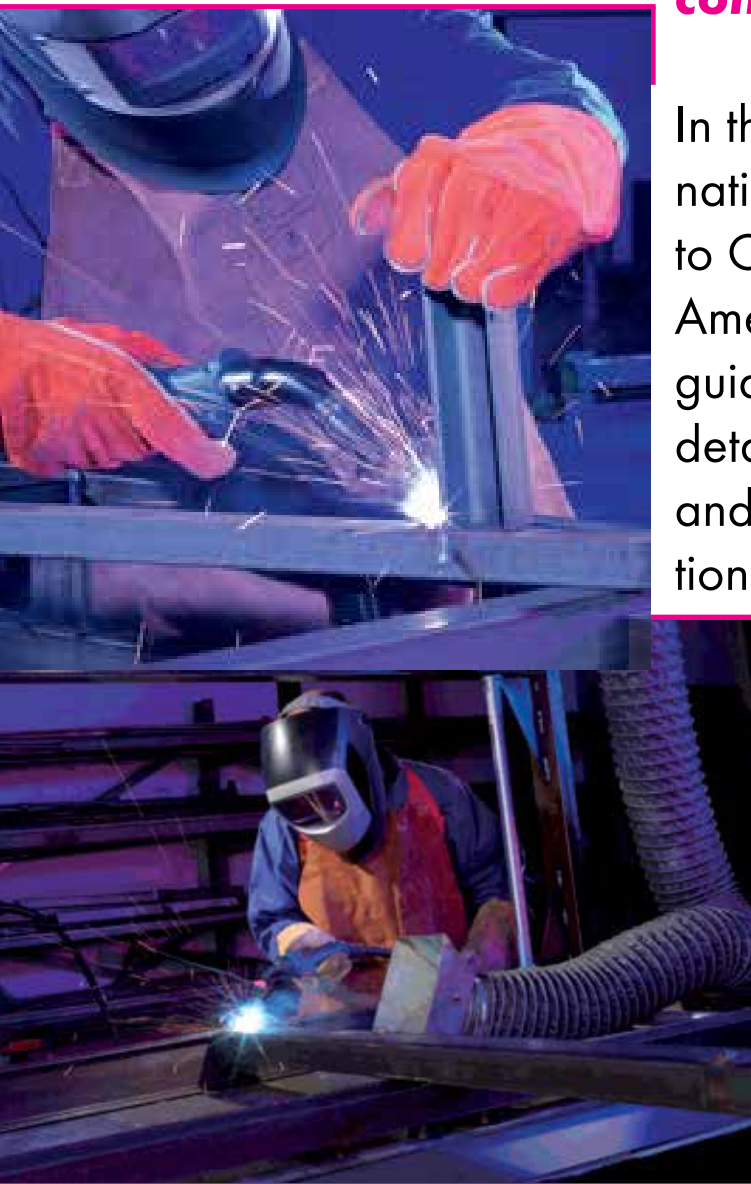


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### III. What are the Regulatory Requirements?

*Where can I get information on how to make sure I'm compliant?*



In the United States, the standards are nationally recognized by OSHA, so refer to OSHA.gov for more information. The American Welding Society likewise has guidelines in ANSI Z49.1 Section 5 that details the allowable limits, ways to test, and best practices in regards to ventilation and special ventilation concerns like confined spaces. It's recommended that you refer to your local Occupational Safety office. In Canada, every province is responsible for their own occupational safety standards, so what's accepted in Ontario may not be proper in Quebec. Also, if you have a safety officer in-house, consult them, as they should be up to date on what you need to do to be

compliant. Also reach out to a Certified Industrial Hygienist who can assess your welders' air quality and help determine the right course of action for you.

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## IV. What Should I Look for in Fume Extraction Solutions?

There are lots of options out there. The right one will depend on your needs. Here we're going to go over what you should be looking for when making that important equipment decision.

### *Your welding operation and how it affects your decision.*

First, we should reiterate that no matter the fume extraction system you choose, you don't have to change your welding procedure or weld-



ing machine equipment. When using a fume extraction torch, you'll keep the same procedures – which including gas and wire – when implementing fume extraction. The only notable adjustment you will be making is using a new welding gun and utilizing a fume collection system – whether centrally located or portable/mobile – to incorporate fume extraction into your operation. If you opt for an LEV or Source Capture Air Clean solution, there won't be any change to

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# IV. What Should I Look for in Fume Extraction Solutions?



your procedure or machine.

If you opt and go the fume gun route, the welding positions your welders currently perform won't change and the welding procedures you currently have in place will not need to be altered just because you're using fume extraction torches – it's a very common concern among those considering the switch, but we can tell you from our years of introducing fume extraction torches to a variety of end users that very few of them have had to change their positions or their operations to accommodate it.



## **For Fume Guns, What Kinds of Options are Out There?**

There are several options available for fume guns on the market. You want to make sure the torch you select has three things going for it: The gun is going to be as light as possible,

### **QUICK TIP!**

**Weight** is always going to be an enormous factor when looking at fume extraction guns. We get it, fume extraction guns have been hefty to handle in the past. But they've made quantum leaps since then in their ergonomics and light-weight design and construction.

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## IV. What Should I Look for in Fume Extraction Solutions?

the gun extracts smoke properly, and the gun allows the welder to access the same welding positions as before.

We recommend a simple comparison test. Take a normal MIG torch and weld regularly. Then, try the fume gun in the same position welding the same piece and make sure it can do what you want. If you want to try out different fume guns, go for it! Then, choose the one that extracts the smoke better. You'll be able to literally see the difference, as the better fume extraction MIG guns remove the fumes right at the arc. Take a camera and film it. You will see the difference very clearly.



Smoke guns look and feel bigger than normal MIG torches because

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## IV. What Should I Look for in Fume Extraction Solutions?

of the design. First, there's the hose that's needed to extract the smoke. Second, the nozzle and the fume shroud on the front end can



be bulkier than normal MIG guns. This tends to turn off welders at first glance, but chances are there is a fume gun out there that meets your welders' demands. Research the market to find the best guns available. Some have smaller or tapered nozzles, smaller grips, better ergonomics, work well in corners and hard to access areas, etc.



Some are also lighter in weight. Weight is a huge factor when considering fume torches. Fume guns used to be heavy (and some still are!) because of the cable weight and the handle design. Research to find ones most comfortable for your welders. There are several fume guns on the market that are just as light and easy to handle as standard

MIG guns.

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## IV. What Should I Look for in Fume Extraction Solutions?

Also look at your consumables. The better the consumable, the more value you will get out of the torch. Consumables with tapered front ends, for instance, would always be preferable because of the ease of maintenance. You also will experience less spatter build up because coarse threading resists binding and stays concentric with the tip holder. Also look for the quality of the consumable. Copper, chrome, copper chrome zirconium, silver, and nickel all are considered high grade consumable materials. The more high-quality the met-



al the better the performance.

### ***What type of fume extraction systems are out there and which is best for me?***

To do smoke extraction at the source with a MIG gun, you will need a high-vacuum system. Whether it's portable or central or mobile, if

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# IV. What Should I Look for in Fume Extraction Solutions?



it isn't a high-vacuum, it's not going to effectively collect welding particles and still be subject to the same amount of health risk as before.

The choice of a portable or central or whatever depends on need. If you have a stationary welding system, you can use a portable or singular unit. However, if you have more than one station, a central vacuum is best. The central vacuum system is easier for the welder to connect to and it is easier to maintain.

Portable fume collection systems are good and generally less costly if you want to install it yourself and need to move to different locations to perform welds while still needing to maintain fume extraction. However, maintenance is more frequent as a result. Portable systems have their own filter and their own motor – and those filters and motors are typically smaller. Also, because it is portable it's



## QUICK TIP!

**Source capture air cleaning** is a very effective fume extraction route to go, because it saves energy costs by filtering the air back into the plant while still capturing fumes. They're for the most part shaped like LEV systems, so keep in mind the same kind of welder awareness of moving the arm applies.

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## IV. What Should I Look for in Fume Extraction Solutions?

more susceptible to damage – being dropped, being hit, as well as just suffering the normal wear and tear of being picked up and let down while being transported. Noise is also a downside, as the source of collection is right next to the welder.



Stationary is pretty much maintenance-free for the welder and is more a plant manager responsibility. So, the welder gets to spend more time welding. Performance is more reliable and stable. Central fume collection stations almost always come with a larger motor and filter so there is less filter changing – just plug the fume extraction gun to the central system and weld. For the welder, there's typically a lot more convenience with the central system. Central systems have unlimited capacity as well – there's no limit to the size of a central system. If you have a large plant operation with 40 or more handhelds arc stations, you can get a sys-

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## IV. What Should I Look for in Fume Extraction Solutions?

tem that can accommodate that if you want to move totally to fume extraction. There's also less noise for the welder because the vacuum is located at a distance.

In terms of downside, the initial investment can induce sticker shock. But, bear in mind that central vacuums require a lot of upfront capital because of the electrical requirements, labor involved in getting it up and running, and the consultation required to introduce a central



vacuum into your plant. However, after the upfront costs, it's a far less costly option to maintain. You won't find yourself replacing filters or cleaning them at nearly the rate you would with a portable system, and because it's fixed to a stationary location, your general maintenance is significantly reduced. Central systems also tend to age well. Many of the options out there will last decades if not longer with minimal maintenance needs.

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## V. Is There a Performance Tradeoff with Fume Extraction

There's usually a question of whether all that additional design and engineering that goes into these fume guns or systems affect the performance of the welder. Is there a loss of amperage? Does it affect gas flow? Will it fatigue my welder more? We answer those concerns below.

### *Am I Sacrificing Performance for Safety?*

While it is argued that fume guns don't 'perform' as well, the answer is no, you won't sacrifice any performance. Today's smoke extraction MIG guns perform just as well as regular MIG guns with capacities from 200 to 500 amp air and water cooled for almost every possible situation a standard MIG gun handles. The guns also feature the same range of features as a standard MIG gun.

The question of gas flow is an equally im-



### **QUICK TIP!**

**Gas flow** with fume extraction torches will always be a concern, but usually it comes down to your welding parameters more than the gun itself. Check to make sure you're getting the necessary flow by using a portable flow meter before striking an arc.

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## V. Is There a Performance Tradeoff with Fume Extraction

portant factor to consider. This speaks a lot to issues of porosity. If the fume shroud is suctioning too strongly, gas is then suctioned into the shroud, causing less gas coverage at the nozzle and poor weld quality. Some fume extraction torch designs are better than others at combating gas dissipation – look at all the options out there to see which designs lend themselves to protecting against poor gas flow. Also check your fume extraction vacuum setting against your gas flow, and always carry a portable gas flow meter to test the suctioning and making sure the gas flow isn't being compromised. Often times when these issues arise it's more a solution of getting the parameters correct than the gun adversely affecting weld quality.



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## V. Is There a Performance Tradeoff with Fume Extraction

### *Is it more Strenuous on my Welders Even if it's Healthier?*



This is a great question, because there are fume extraction guns that can be heavy and bulky to handle, which can affect welders' stamina. But, even the strain of using a fume extraction torch would depend on the gun you're changing from and the smoke gun you're choosing, because there are fume guns out there that achieve the same feel and handle as most MIG guns on the market.



It's also a matter of welding positions. Overhead and vertical welds by their very nature are more straining weld positions than horizontal or down welds, so heavier fume extraction torches could be more strenuous and adversely affect performance because if the torch isn't positioned properly it won't capture the fume as much as it could.

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## V. Is There a Performance Tradeoff with Fume Extraction

However, these concerns and the guns' performance again depends on the MIG gun being switched from and the fume gun in question. Take a demo and see if the difference is real.

You can find plenty of MIG guns out there with the ball socket flex at the base of the cable, and there are plenty of cables out there that weigh the same as many non-fume extracting MIG torches on the market. Do your research and talk to your welding supplier or a quali-



fied manufacturing rep.

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# Conclusion



## About the Author

Etienne Blouin is Regional Sales Manager for ABICOR BINZEL in Canada. Etienne has developed an expertise in smoke extraction and helped ABICOR BINZEL make design improvements in BINZEL's line of fume extraction products, and has helped numerous welding end users in Quebec and other areas of Canada as well as the United States introduce fume extraction to their welding operation.

Etienne studied Physics Engineering at Laval University in Quebec. You can reach Etienne at [eblouin@binzel.ca](mailto:eblouin@binzel.ca)

Today you want welders to be in a safer, healthier environment. Healthier welders mean happier welders, which fosters better performance for your operation.

There have been a lot of options introduced to the market for fume extraction, and there are many ways to introduce fume extraction into your plant no matter the number of arc stations you have or the budget you're able to dedicate towards it. If you're still skeptical, ask your welding supplier to provide you a demo or a trial with a fume gun in your own work environment and see if there's a difference. It's no risk!

Chances are you'll be surprised, and may look at fume extraction in a whole new light.

If you want to talk more fume extraction, please contact me at: [eblouin@binzel.ca](mailto:eblouin@binzel.ca)

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# Now What?



## About ABICOR BINZEL

ABICOR BINZEL is a global manufacturer and maker of welding torches and accessories for the MIG, TIG, and Plasma process. With torches made for air and water-cooled in both handheld and robotic. Our standard, push-pull, and fume extraction torches and torch accessories increase value and productivity in welding operations worldwide.

Based in Buseck, Germany with additional manufacturing locations in the United States, Brazil, India, Russia, and China, BINZEL is Technology for the Welder's World.

So you've read up on fume extraction, and know all the pitfalls and necessary considerations to make as you go through the process of deciding on fume extraction solutions.

Why not ask us for more? Feel free to contact us at [binzel-abicor.com](http://binzel-abicor.com) to speak to a qualified ABICOR BINZEL Sales Manager or Technical Support and see if we have a solution for your needs.

In the meantime, subscribe to our blog, follow us on social media, and be on the lookout for ABICOR BINZEL welding solutions in local welding and gas distributors or trade shows in your area.

Thanks for reading!

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