



# EMERGING TECHNOLOGY FOR SOURCE FUME EXTRACTION MIG GUN

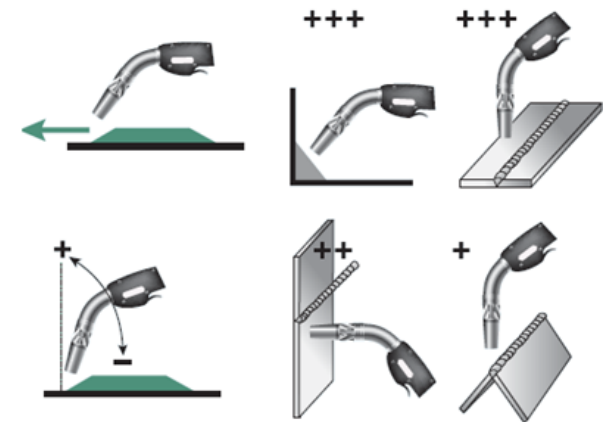
## Benefits of Using Emerging Technology in Source Fume Extraction MIG Guns

1. Compliance with the new standard for a maximum manganese oxide concentration of 0.02 mg/m<sup>3</sup> in the welder's breathing zone.
2. Offers a lighter and more ergonomic Metal Inert Gas (MIG) gun that improves welders' working conditions and efficiency.

## FumeVac® Addresses the Challenges of Capturing Welding Fumes at the Source

With over 150 years of combined experience, the FumeVac team has been involved in developing the most effective, industry-leading technology to capture welding fumes at the source using vacuum-assisted guns. This is a solution specific to the MIG process, which is the most widely used in the industry.

In the first few years, the results from this process were varied. It became evident that the gun's efficiency depended on both the welding position and the parameters applied (power, wire type, shielding gas type). In some positions, fumes are naturally directed toward the suction slots, which facilitates capture. When the power is increased, the volume and upward velocity of fumes generated by the welding process also increase. To determine the most appropriate air flow to maintain adequate capture efficiency in all circumstances, the FumeVac team constructed a model to replicate these common conditions and experimented with these variables.



Capture is improved when the MIG gun's air suction is increased; however, care should be taken as there is a risk of porosity. In some positions, mainly in confined areas, shielding gas could be drawn in. This issue was especially prevalent in first-generation guns designed in the 1980s, as the suction slots were very close to the weld point. To maintain capture efficiency without creating porosity, the distance of these slots from the weld point and the gun's air flow rate were increased.

In partnership with a European company, the FumeVac team has been creating effective solutions for many years. In February 2013, the American Conference of Governmental Industrial Hygienists (ACGIH) published recommendations to reduce the standard of maximum manganese oxide concentration in the welder's breathing zone from 0.2 mg/m<sup>3</sup> to 0.02 mg/m<sup>3</sup> due to the demonstrable risk to worker health. Samples were taken at several units and it became evident that available MIG guns could not consistently adhere to the new recommendation. The team had to rework their solution to address this game-changing industry standard.

**MAXIMUM MANGANESE OXIDE CONCENTRATION OF  
0.02 MG/M<sup>3</sup> IN THE WELDER'S BREATHING ZONE**

0.2 mg/m<sup>3</sup>



0.02 mg/m<sup>3</sup>

## The Development of FumeVac®

The FumeVac gun was developed to adhere to the new standard for maximum manganese oxide concentrations in the welder's breathing zone. The development of this new MIG gun required several prototypes, extensive laboratory trials, and field testing with users and sampling. The end result not only improves welders' breathing zone protection, it also has better ergonomic features than other guns in the market as it is lighter and its handle is less restrictive.

## Field Testing

A steel parts manufacturer tested out the FumeVac gun over several days and in 2017, an independent company, Le Groupe Gesfor Poirier, Pinchin Inc., was commissioned to perform sampling. Testing was performed in accordance with methods and protocols recognized in Canada and the United States. The sampling filter was installed inside the welder's helmet. The gun was tested in 8-hour shifts over three sampling days. These tests served to validate adherence to ACGIH's recommendations relating to maximum manganese oxide concentrations of 0.02 mg/m<sup>3</sup> in the welder's breathing zone using standard industry configurations:

- 0.052" solid wire with shielding gas 92% Argon 8% CO<sub>2</sub> – flat and corner welding
- metal core wire 0.052" with shielding gas 92% Argon 8% CO<sub>2</sub> – flat and corner welding
- flux core wire 1/16" with shielding gas 100% CO<sub>2</sub> – flat and corner welding and horizontal on vertical wall and vertical upright

The vacuum unit used during sampling was the IVFE-225-3, manufactured by IVEC Systems®. The FumeVac team selected this equipment because it offers the required vacuum level to produce an air flow that ensures the efficient source capturing of welding fumes.

## Results of Sampling Using FumeVac®

The detailed results of sampling are contained in the following tables. Tests validated that the FumeVac source fume extraction MIG gun, when combined with the appropriate vacuum source, ensures adherence to ACGIH recommendations with regard to maximum manganese oxide concentrations of 0.02 mg/m<sup>3</sup> in the welder's breathing zone. The results were satisfactory even with stringent welding parameters (power, duty cycle) and with varying working positions. As expected, the vertical upright position is the best position for efficient capture of welding fumes. The results show that compliance with the ACGIH Threshold Limit Value (TLV) recommendation is achieved when the correct flow and vacuum in the MIG gun are used and the suction holes are positioned at a sufficient distance to avoid porosity.

	Welding fumes (mg/m <sup>3</sup> )	Manganese (mg/m <sup>3</sup> )
<b>ACGIH</b>	<b>3</b>	<b>0.020</b>
<b>Solid wire</b>	<b>0.69</b>	<b>0.015</b>
<b>Metal Core</b>	<b>0.45</b>	<b>0.010</b>
<b>Flux Core</b>	<b>0.46</b>	<b>0.010</b>

**Table 1: Results of sampling for 0.052" solid wire**

WORK STATION	SAMPLING PERIOD	DURATION (MIN)	SAMPLE NO.	CONTAMINANT	MEASURED CONCENTRATION (mg/m <sup>3</sup> )	PEL*	TLV
						OSHA (mg/m <sup>3</sup> )	ACGIH <sup>MD</sup> (mg/m <sup>3</sup> )
Area sampling	8:26 a.m. to 4:02 p.m.	456	P082117026	Welding fumes	0.16	5	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.0025	5	Inhalable: 0.1 Respirable: 0.02
<u>General Observations</u> The area sampler was installed at approximately 10 ft behind the welder and 4 ft from the wall of the adjacent section.							
Welder	8:25 a.m. to 11:52 a.m. 12:34 p.m. to 4:01 p.m.	414	P082117017	Welding fumes	0.69	5	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.015	5	Inhalable: 0.1 Respirable: 0.02
<u>General Observations</u> The sampling filter was installed inside the welder's helmet. Welding with solid wire / Wire used: Easyarc 706 Arcweld Shielding gas: Argoshield <sup>MC</sup> 8C (92 % argon and 8% carbon dioxide)					Average tension: 31.14 V Average intensity: 305.69 A Welding time for the day: 39.82 %		

\*Permissible Exposure Limit

**Table 2: Results of sampling for 0.052" metal core wire**

WORK STATION	SAMPLING PERIOD	DURATION (MIN)	SAMPLE NO.	CONTAMINANT	MEASURED CONCENTRATION (mg/m <sup>3</sup> )	PEL	TLV
						OSHA (mg/m <sup>3</sup> )	ACGIH <sup>MD</sup> (mg/m <sup>3</sup> )
Area sampling	8:49 a.m. to 4:26 p.m.	457	P082117030	Welding fumes	0.23	5	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.0037	5	Inhalable: 0.1 Respirable: 0.02
<u>General observations:</u> The area sampler was installed at approximately 10 ft behind the welder and 4 ft from the wall of the adjacent section.							
Welder	8:47 a.m. to 11:52 a.m. 12:32 p.m. to 4:30 p.m.	423	P082117019	Welding fumes	0.45	5	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.010	5	Inhalable: 0.1 Respirable: 0.02
<u>General observations:</u> The sampling filter was installed inside the welder's helmet. Arc welding with a metal core wire / Wire used: FabCOR <sup>MD</sup> 86R Shielding gas: Argoshield <sup>MC</sup> 8C (92 % argon and 8% carbon dioxide)					Average tension: 27.20 V Average intensity: 325.00 A Welding time for the day: 41.13 %		

**Table 3: Results of sampling for 1/16" flux core wire**

WORK STATION	SAMPLING PERIOD	DURATION (MIN)	SAMPLE No.	CONTAMINANT	TIME WEIGHTED AVERAGE CONCENTRATION FOR THE TIME SAMPLED (mg/m <sup>3</sup> )	PEL	TLV
						OSHA (mg/m <sup>3</sup> )	ACGIH <sup>MD</sup> (mg/m <sup>3</sup> )
<b>Area sampling</b>	8:50 a.m. to 4:29 p.m.	459	P082117008	Welding fumes	< 0.072	5	Inhalable: 10.0 Respirable: 3.0
				Manganese	< 0.0014	5	Inhalable: 0.1 Respirable: 0.02
	<p><u>General observations:</u> The area sampler was installed at approximately 10 ft behind the welder and 4 ft from the wall of the adjacent section.</p>						
<b>Welder</b>	8:49 a.m. to 11:50 a.m.* 12:47 p.m. to 2:27 p.m.** 3:06 p.m. to 4:29 p.m.***	362	P082117021	Welding fumes	0.46	5	Inhalable: 10.0 Respirable: 3.0
			P082117004 P082117027	Manganese	0.010	5	Inhalable: 0.1 Respirable: 0.02
	<p><u>General observations:</u> The sampling filter was installed inside the welder's helmet. Welding with flux core wire / Wire used: Excel Arc<sup>MD</sup> 71 Shielding gas: carbon dioxide Total welding time for the day: 39.04 %</p>						
	<b>*Flat and angled welding</b>			<b>**Horizontal welding on a vertical wall</b>		<b>***Vertical welding</b>	
	Average tension: 31.76 V			Average tension: 25.30 V		Average tension: 19.98 V	
	Average intensity: 285.08 A			Average intensity: 226.89 A		Average intensity: 208.19 A	
	Welding time: 41.36 %			Welding time: 39.31 %		Welding time: 33.64 %	