

DEVELOPING A NEW SOURCE FUME EXTRACTION MIG GUN

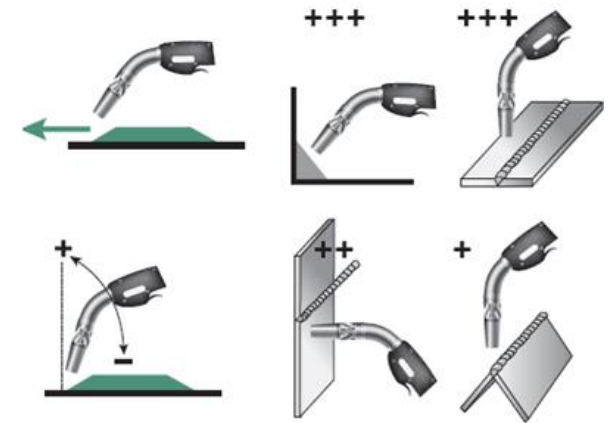
Benefits of Using Emerging Technology in Source Fume Extraction MIG Guns

1. Compliance with the new standard for a maximum manganese concentration of 0.02 mg/m³ in the welder's breathing zone.
2. Offers a lighter and more ergonomic MIG gun for improving welders' working conditions and efficiency.

AIRGOMIG® Addresses the Challenges of Capturing Welding Fumes at the Source

For almost 30 years, the AIRGOMIG® 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 depends 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 AIRGOMIG® team constructed a model to replicate these common conditions and experiment 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 should be increased.

The AIRGOMIG® team has been creating effective solutions for the North American market for many years in partnership with a European company. In February 2013, the ACGIH published recommendations to reduce the standard of maximum manganese

MAXIMUM MANGANESE CONCENTRATION IN THE WELDER'S BREATHING ZONE

0.2 mg/m³



0.02 mg/m³

concentration in the welder's breathing zone from 0.2 mg/m³ to 0.02 mg/m³ due to the risks demonstrated for workers' health. Samples were taken at several units and it became evident that the vacuum MIG guns available on the market would never consistently adhere to this new recommendation. The team had to rework their solution to address this game-changing industry standard.

Development of AIRGOMIG®

The AIRGOMIG® gun was developed to adhere to this new standard for maximum manganese concentrations in the welder's breathing zone. The development of this new MIG gun required several prototypes, extensive laboratory trials, and real-life situations with users and sampling. Not only did the end result offer improved welders' breathing zone protection, the gun also has better ergonomic features as compared to other guns on the market as it is lighter and its handle is less restrictive.

Real-life Sampling

A steel parts manufacturer tested out the AIRGOMIG® gun over several days and 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 being 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 concentrations of 0.02 mg/m³ in the welder's breathing zone using standard industry configurations:

- 0.052" solid wire with shielding gas 92% Argon 8% CO₂ – flat and corner welding;
- metal core wire 0.052" with shielding gas 92% Argon 8% CO₂ – flat and corner welding;
- flux core wire 1/16" with shielding gas 100% CO₂ – flat and corner welding and horizontal on vertical wall and vertical upright.

The vacuum unit used during sampling was HVMAX-02, manufactured by Henlex Inc. The AIRGOMIG® team selected this equipment because it offers the required vacuum level to produce an air flow that will ensure the efficient source capturing of welding fumes.

Results of Sampling Using AIRGOMIG®

The detailed results of sampling are contained in the following tables. Tests validated that the AIRGOMIG® source fume extraction MIG gun, combined with the appropriate vacuum source, ensures adherence to ACGIH recommendations with regard to maximum manganese concentrations of 0.02 mg/m³ 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 most critical position for efficient capture of welding fumes. The results point to compliance with the ACGIH TLV recommendation 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 ³)	Manganese (mg/m ³)
ACGIH	3	0.020
Solid wire	0.69	0.015
Metal Core	0.45	0.010
Flux Core	0.46	0.010

Table 1: Results of Sampling for 0.052” Solid Wire

WORK STATION	SAMPLING PERIOD	DURATION (MIN)	SAMPLE NO.	CONTAMINANT	MEASURED CONCENTRATION (mg/m ³)	EXPOSURE LIMIT VALUES ACGIH ^{MD} (mg/m ³)
Area sampling	8:26 a.m. to 4:02 p.m.	456	P082117026	Welding fumes	0.16	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.0025	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	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.015	Inhalable: 0.1 Respirable: 0.02
<u>General Observations</u> Welding with solid wire Wire used: Easyarc 706 Arcweld Shielding gas: Argoshield ^{MC} 8C (92 % argon and 8% carbon dioxide)					Average tension: 31.14 V Average intensity: 305.69 A Welding time for the day: 39.82 %	

Table 2: Results of Sampling for 0.052” Metal Core Wire

WORK STATION	SAMPLING PERIOD	DURATION (MIN)	SAMPLE NO.	CONTAMINANT	MEASURED CONCENTRATION (mg/m ³)	EXPOSURE LIMIT VALUES ACGIH ^{MD} (mg/m ³)
Area sampling	8:49 a.m. to 4:26 p.m.	457	P082117030	Welding fumes	0.23	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.0037	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	Inhalable: 10.0 Respirable: 3.0
				Manganese	0.010	Inhalable: 0.1 Respirable: 0.02
<u>General observations:</u> Arc welding with a metal core wire Wire used: FabCOR ^{MD} 86R Shielding gas: Argoshield ^{MC} 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 ³)	EXPOSURE LIMIT VALUES		
						ACGIH ^{MD} (mg/m ³)		
Area sampling	8:50 a.m. to 4:29 p.m.	459	P082117008	Welding fumes	< 0.072	Inhalable: 10.0 Respirable: 3.0		
				Manganese	< 0.0014	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	8:49 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	Inhalable: 10.0 Respirable: 3.0		
			P082117004	Manganese	0.010	Inhalable: 0.1 Respirable: 0.02		
	P082117027	<u>General observations:</u> Welding with flux core wire Wire used: Excel Arc ^{MD} 71 Shielding gas: carbon dioxide Total welding time for the day: 39.04 %						
	* Flat and angled welding			** Horizontal welding on a vertical wall		*** Vertical welding		
	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 %		