



WINNIPEG
Air Testing

Practical Health and Safety Solutions

5 Donwood Drive, Winnipeg, MB, R2G 0V9

Phone (204) 668-3141

Email: contact@winnipegairtesting.com

ABC Inc.
1 Second Street
Winnipeg, Manitoba
Bob Smith
bob@abcinc.com

January 15, 2020

Project Number: 1234

AIRBORNE MANGANESE EXPOSURE SURVEY

Dear Client:

Please find below the results of the airborne metals survey performed at ABC Inc. located at 1 Second Street, Winnipeg on January 1, 2020.

Background

One of the main processes in the shop is MIG welding on mild steel and galvanized steel. Air testing was performed to evaluate the airborne concentrations in the shop and personal exposures of some of the workers including welders.

Experience has shown that manganese is the “weak link” of welding fume in that it represents the vast majority of worker exposure. Accordingly, sampling was performed for manganese.

Methodology

Personal samples were collected by having the workers wear a sampling train consisting of a small pump, a tube running up to the collar of the worker, and an MCE filter cassette. The sampling equipment worn by the workers was positioned in order to collect air from their breathing zones using “in-mask” sampling systems for welders. Area samples were collected using the same equipment but the sampling train was located in a fixed position as opposed to being worn by a worker.

The samples were collected using normal industrial hygiene sampling pumps. A flowrate of 2 litres per minute was used for all samples. The samples were analysed at an AIHA-accredited laboratory using NIOSH (National Institute of Occupational Safety and Health) Analytical Method 7300 for manganese.

Images of Types of Samples Taken



Personal



Area (low)



Area (high)

Allowable Exposure Limits

The airborne results were compared to the 2019 Threshold Limit Value (TLV) for manganese of $20 \mu\text{g}/\text{m}^3$ ($0.02 \text{ mg}/\text{m}^3$). TLVs represent time-weighted average airborne concentrations to which it is believed that a worker can be exposed, 8 hours per day, 40 hours per week, without adverse effect. The 2019 TLVs have been adopted in the Safety and Health legislation as the allowable exposure guidelines in Manitoba. The 2020 manganese TLV is also $20 \mu\text{g}/\text{m}^3$.

Results

The results from the manganese samples are provided in the following tables. A copy of the lab results has been appended.

Sampling Results of Welder Manganese Exposures

Worker	Manganese Concentration ($\mu\text{g}/\text{m}^3$)	Controls	Exposure with Controls ($\mu\text{g}/\text{m}^3$)
Worker 1	167	Gun Exhaust, Half-face respirator (P100 filters)	16.7
Worker 2	26	Gun Exhaust	26
Worker 3	75	Gun Exhaust, Half-face respirator (P100 filters)	7.5
Worker 4	35	Gun Exhaust	35
2019 Manganese TLV = $20 \mu\text{g}/\text{m}^3$			

All of the welding stations had a gun exhaust ventilation system. Despite the presence of gun exhaust, there was significant emissions from the welding – more than normally observed when gun exhaust systems are working as intended.

Two of the workers tested wore respiratory protection in the form of half-face elastomeric respirators with P100 particulate filters. These respirators, when used as part of a comprehensive respiratory protection program (which includes fit testing, worker education, workers that are clean shaven, etc.) have an assigned protection factor of 10. That is to say that the worker’s exposure when using such a respirator is 10 times less than the concentration measured outside the mask (as measured by the personal sample results).

With the use of respirators, both Worker 1 and Worker 3 had manganese exposures under the TLV on the day of testing. In comparison, Worker 2 and Worker 4 were not wearing respirators and their exposures were well above the TLV. Additional controls are recommended for these workers.

Sampling Results of Area Manganese Concentrations

Area	Manganese Concentration ($\mu\text{g}/\text{m}^3$)
Area 1 - West	11.9
Area 2 - East	12.2
Area 3 - High	14.6
Area 4 - North	10.3
2019 Manganese TLV = 20 $\mu\text{g}/\text{m}^3$	

The area samples were under the TLV on the day of testing. The results give an indication of what concentration other workers (non-welders) around the area are exposed to. The combination of controls in place at the time of testing appear to result in manganese concentrations in the welding area that are within the allowable concentrations of manganese.

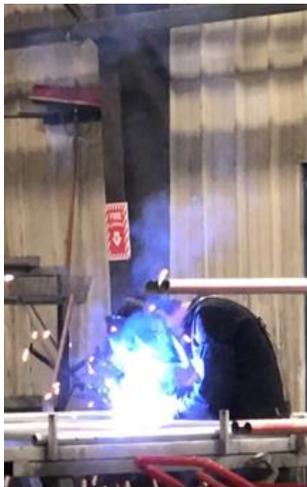
Discussion

The manganese levels were above the current TLV for two out of the four welders tested. The welders are all performing similar tasks on different parts and their exposures should be looked at as a group. Additional controls are needed to reduce exposures. In general, the introduction of controls should follow a control hierarchy where the most effective controls are considered first and the least desirable controls considered last.

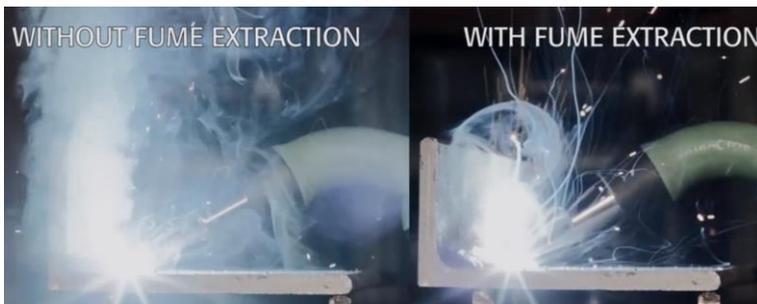
A summary of different controls and their respective degree of effectiveness to reduce welding exposures is provided below. These estimates of exposure reduction are based on our experience of testing and evaluating control solutions.

Control Option	% Reduction	Comment
Lower Mn Welding Wire	20-70%	Essentially zero cost, proven effective
Local Exhaust Extraction	80%	High initial cost, high level of control
Gun Exhaust System	55-60%	Somewhat less effective than above
Pulse Setting	30-40%	Zero cost, still gives good weld
Voltage Reduction	20-40%	Zero cost, need to verify weld quality
Change Work Position	80%	Rearrange work station so worker is out of the plume. Better ergonomics too
Respiratory Protection	90%	High ongoing costs and comfort issues

Mn = manganese



The inspector noticed a clearly visible plume of smoke rising from the welding. The welders reportedly have gun exhaust systems. Gun exhaust systems are designed to catch the fume at the point of emission. A properly designed and maintained gun exhaust system should capture a large portion of the welding fume smoke. Typically, under normal operating (i.e., less than ideal) conditions, a gun exhaust system should capture 50 – 60% of the welding plume. Based on simple observation, the gun exhaust systems do not appear to be achieving this level of extraction. These gun exhaust systems often clog at the gun and require daily inspection and cleaning to ensure their proper operation.



The images on the left show the effect of a gun exhaust system. There is very little fume that escapes from the capture radius of the gun exhaust system.



The welder on the left has gun exhaust and the welder on the right does not. Which one looks most like your welders?

In light of the magnitude of the exposures, the following actions are recommended:

1. All workers who are welding should wear a half-face respirator with P100 filters. The two workers wearing respirators had exposures below the TLV for manganese and the two welders not wearing a respirator had exposures above the TLV.
2. The performance of the gun exhaust appears suspect. It is likely that normal maintenance and daily inspection and cleaning of the guns will result in significantly better capture. This will reduce both the welders' exposures, as well as the general manganese levels in the welding area.

Conclusion

Some of the welders were overexposed to manganese. The introduction of mandatory respirator use for all welders is recommended. The gun exhaust systems should be cleaned and maintained on a daily basis to ensure they are working properly.

I hope this information is of assistance to you. Should you have any questions, or if we can be of any further assistance, please contact me at (204) 668-3141.

Sincerely,

Winnipeg Air Testing
Per:

Angela Concepcion

Angela Concepcion, B. Sc. (Hons)
Industrial Hygienist

Reviewed by:

Douglas N. Wylie

Doug Wylie, CIH, ROH, CRSP, CRM
Occupational Hygienist

Copy of Laboratory Results

Results deleted in sample report