



WELDING SAFETY

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THIS PRESENTATION FOCUSES ON FINDING SOLUTIONS TO IMPROVE THE WORK ENVIRONMENT, SPECIFICALLY:



Types of welding and some associated hazards



Acute and chronic health effects



Assessing the effectiveness of welding fume control



Available controls for welding fumes



The future of welding and safety

WELDING

Welding is the fusion of similar or dissimilar metals by heating them to proper temperature with or without pressure, filler materials and flux.

In Ontario approximately 28,850 work as professional welders

Sectors:

- Fabricated metal product manufacturing 20%
- Repair, Maintenance 14%
- Motor vehicle parts 12%
- Machinery manufacturing 11%
- Construction 11%

Over 95% of welders are full time workers. (79% all occupations)

Less than 5% part time workers (21% all occupations)



(Source: Department of Employment and Social Development Statistics Canada)

TYPES OF WELDING

80-90%

Resistance Welding

Weld is generated by the electrical resistance, pressure (spot and seam welding)

Gas Welding

Use fuel gases and oxygen to weld and cut metals, (process of oxy/ acetylene, propane)

Solid State Welding

Temperature increase below melting point cause base materials being fused.

Newer Welding

Electron ,Laser beam welding

Arc Welding

- **Shielded Metal Arc Welding(stick) (SMAW)**
- **Flux Cord Arc Welding (FCAW)**
- **Gas Metal Arc Welding (GMAW or MIG)**
- **Tungsten Inert Gas Welding (GTAW or TIG)**



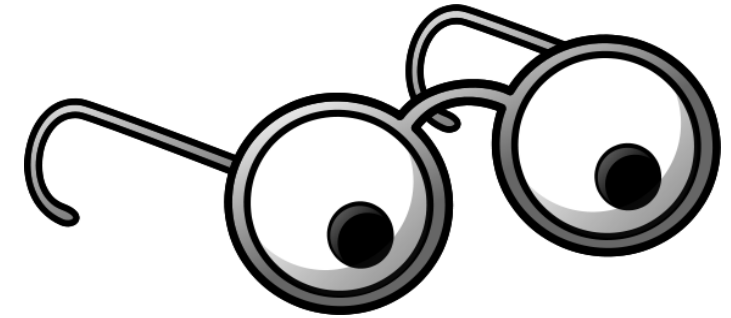
HAZARDS OF WELDING FUME

Typical Safety Data Sheet of a commonly used covered electrode for electric arc welding

During welding processes, metal fumes and gas by-products are generated. Those fumes and gases can be harmful.

Important to provide information and educate workers on hazards

Greater awareness and understanding emphasizes the importance of isolation from fumes.



Section 2. Hazard identification

Classification of the substance or mixture

- : H317 SKIN SENSITIZATION - Category 1
- : H350 CARCINOGENICITY - Category 1
- : H361 TOXIC TO REPRODUCTION (Fertility) - Category 2
- : H373 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (bones, central nervous system (CNS), lungs and teeth) - Category 2

GHS label elements

These hazards relate to welding fumes (electrodes in use) and not to the electrodes as sold.

Hazard pictograms



Signal word : Danger

Hazard statements

- : H317 - May cause an allergic skin reaction.
- : H350 - May cause cancer.
- : H361 - Suspected of damaging fertility.
- : H373 - May cause damage to organs through prolonged or repeated exposure. (bones, central nervous system (CNS), lungs, teeth)

Ingredient name	% (w/w)	CAS number
iron	45 - 70	7439-89-6
titanium dioxide	0.1 - 15	13463-67-7
calcium carbonate	0.01 - 15	471-34-1
calcium fluoride	0.01 - 10	7789-75-5
Zirconium	0.01 - 6	7440-67-7
manganese	0.01 - 4	7439-96-5
Ferrosilicon	0.01 - 2.5	8049-17-0
aluminum oxide	0.01 - 2	1344-28-1
Silicic acid, sodium salt	0.01 - 1.5	1344-09-8
crystalline silica, respirable powder	0.1 - 1	14808-60-7
titanium	0.01 - 0.9	7440-32-6
copper	0.01 - 0.5	7440-50-8
Nickel	0.01 - 0.5	7440-02-0
molybdenum	0.01 - 0.15	7439-98-7

FACTORS THAT AFFECT EXPOSURE

- 👤 Type of welding process. Shielded Metal Arc Welding(stick) vs. Tungsten Inert Gas Welding
- 👤 Composition of welding rod (silica, calcium fluoride) low fume flux cored wire
- 👤 Filler metals and base metal used (mild steel, stainless steel)
- 👤 Type of coatings present (zinc, paint with lead)
- 👤 Location (open area or confined space)
- 👤 Type of ventilation controls (mechanical or local)
- 👤 Work practices of welder (e.g. remove coatings, clean surfaces, stay upwind)



EFFECTS ON HEALTH

ACUTE

- * Eye, nose and throat irritation,
- * Dizziness
- * Nausea.
- * Metal fume fever,
- * Gases such as helium, argon, and carbon dioxide can lead to suffocation, (confined spaces)
- * Carbon monoxide gas can form asphyxiation hazard.



CHRONIC

- * Lung damage
- * Various types of cancer, including lung, larynx and urinary tract
- * Stomach ulcers
- * Kidney damage
- * Nervous system damage.
- * Prolonged exposure to manganese fume can cause Parkinson's-like symptoms.



ASSESSING THE EFFECTIVENESS OF WELDING FUME EXTRACTION



Assessment can be conducted through:



Photography



Visual
observation



Air flow
measurements



Personal and/or area
exposure monitoring



PHOTOGRAPHY



A picture is worth a thousand words

- Still pictures can determine if the fumes are entering the breathing zone of the worker
- Pictures can also determine if the ventilation hood effective



VISUAL OBSERVATION



└─ Visible fume and dust emissions
(best to do after few hours of welding)

└─ Worker complaints *(talking to workers about issues and possible solutions)*

└─ Failure to meet occupational exposure limits *(personal and area monitoring)*

└─ Premature plugging of filters and related equipment issues *(undersized filtration system)*





AIR FLOW MEASUREMENTS

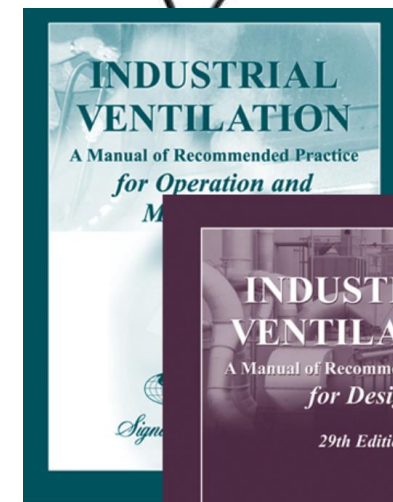
Duct velocity 3000 fpm

Face velocity 1500 fpm

Capture velocity 100-170 fpm

with higher values for high cross draft conditions and higher hazard level

12 inch



Recommended flow readings from ACGIH



PERSONAL AND AREA EXPOSURE MONITORING

Regulation 833, Control of Exposure to Biological or Chemical Agents



Ontario Table Listings	Agent [CAS No.]	Time-Weighted Average Limit (TWA)
	Magnesium oxide [1309-48-4]	10 mg/m ³ (I)
	Malathion [121-75-5]	1 mg/m ³ (IFV)
	Maleic anhydride [108-31-6]	0.01 mg/m ³ (IFV)
◇	Manganese [7439-96-5] elemental and inorganic compounds, as Mn	0.2 mg/m ³
	Manganese cyclopentadienyl tricarbonyl [12079-65-1], as Mn	0.1 mg/m ³

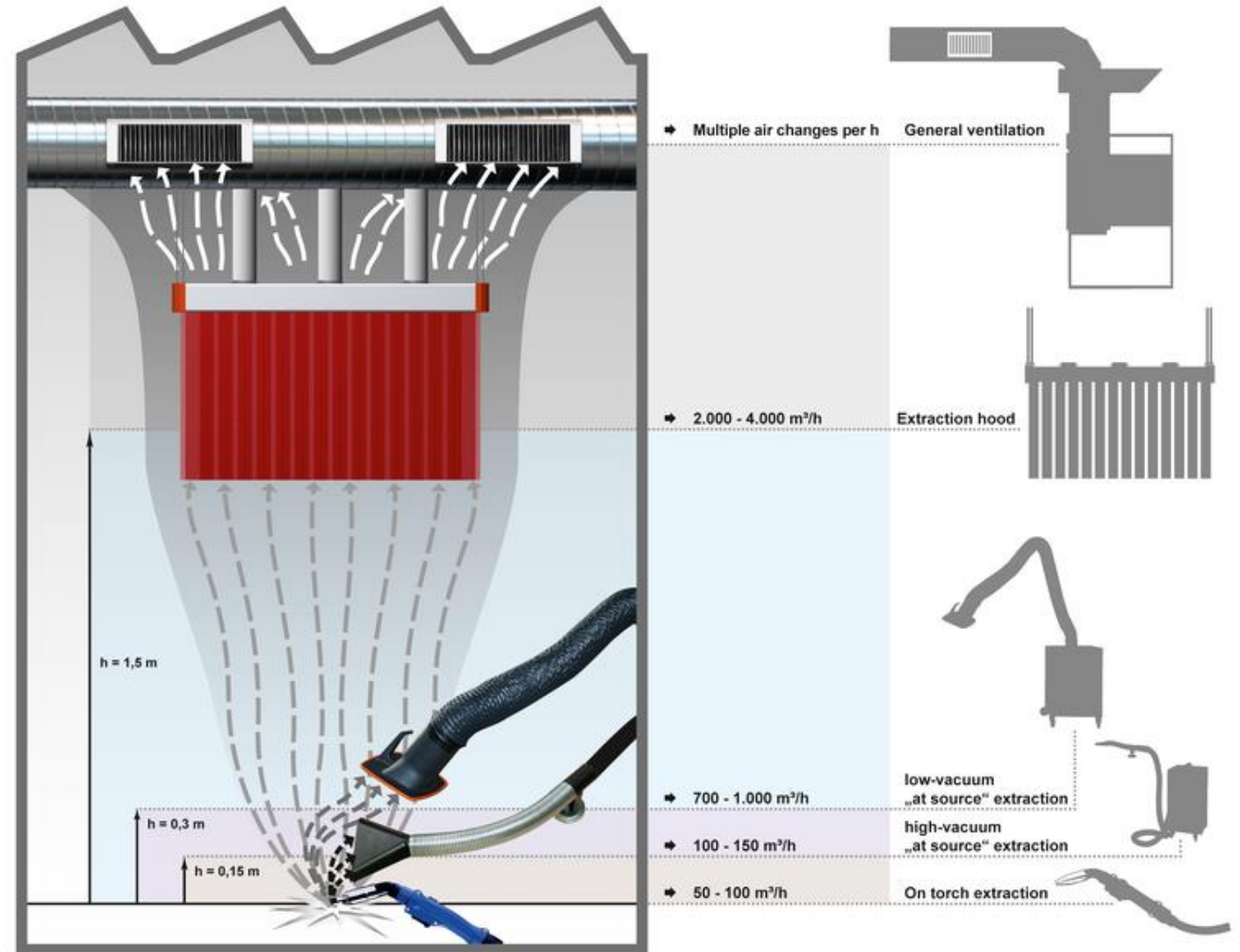


Common Agents to Measure

Fume	Source
Chromium	Stainless steel
Iron Oxide	Iron and steel welding
Manganese	Most welding processes
Nickel	Stainless steel, high-alloy materials, welding rods, and plated steel.

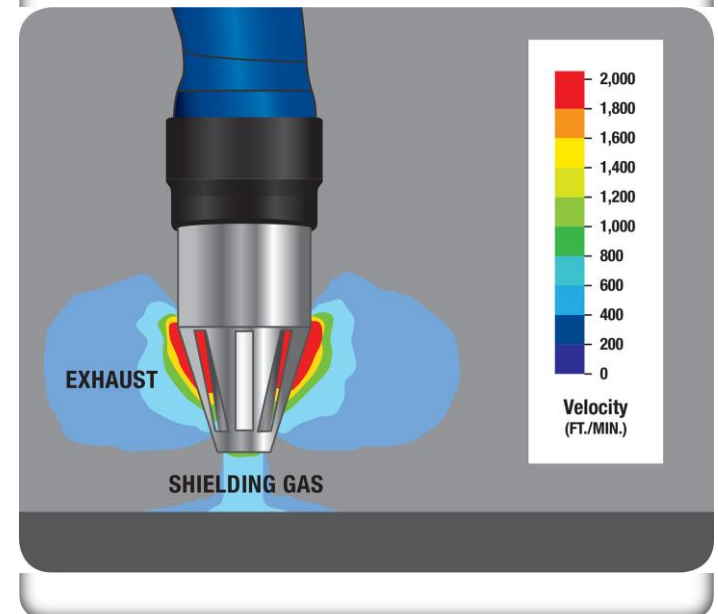
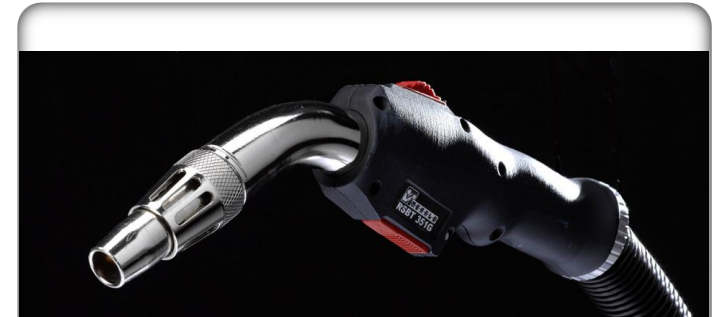
AVAILABLE CONTROLS FOR DIFFERENT APPLICATIONS

- 👤 On torch extraction
- 👤 High vacuum at source extraction
- 👤 Low vacuum at source extraction
- 👤 Extraction hood
- 👤 Down draft tables
- 👤 General ventilation



ON TORCH EXTRACTION

- ✎ The first on-torch solution was introduced in the 1980 (very cumbersome) today they are lighter and more ergonomic. They have high capture rates using relatively low air flows
- ✎ Capture the fumes directly at its point of generation
- ✎ Works with continuous wire welding processes, practical with long and large pieces










HIGH VACUUM AT SOURCE EXTRACTION

- ↳ At source extraction
- ↳ The extraction system hoses and duct sizes are usually very small and can be easily moved about the work area or used in confined spaces
- ↳ Draws the air at a very high air transport velocity and high pressure, but at a low air volume, typically 50 - 160 CFM
- ↳ Low maintenance
- ↳ Economical to operate, simple connection to the extraction system by hoses
- ↳ May be direct connected to MIG extraction gun
- ↳ Magnetic or tripods support base ensures hands free operation in tight places, easily manipulated



LOW VACUUM AT SOURCE EXTRACTION





-  Most commonly used fume control method in shops and garages
-  Removes a large volume of air at low transport velocity and low system pressure
-  Easy positioning of extraction arm
-  Low maintenance
-  Custom design can meet facility and application requirements
-  Larger amount of air removed from operator's breathing zone
-  Lower noise level






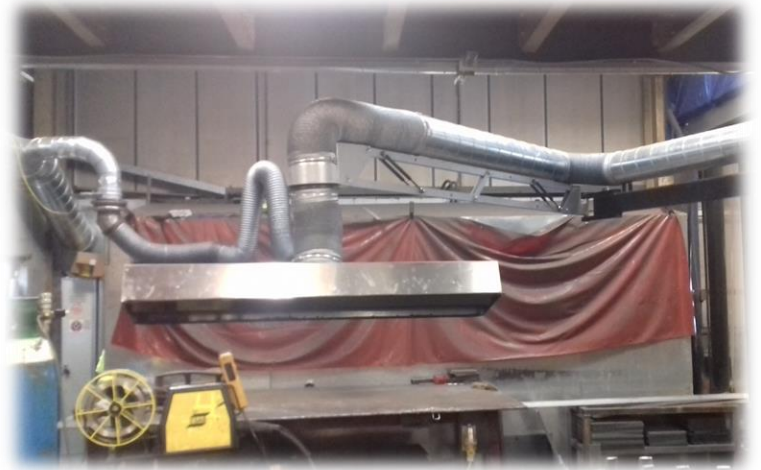
EXTRACTION HOOD

Movable or fixed hood above the work table

-  Place welding curtains or other barriers to block cross draft
-  Install turn tables, work rest to improve utilization of the hood

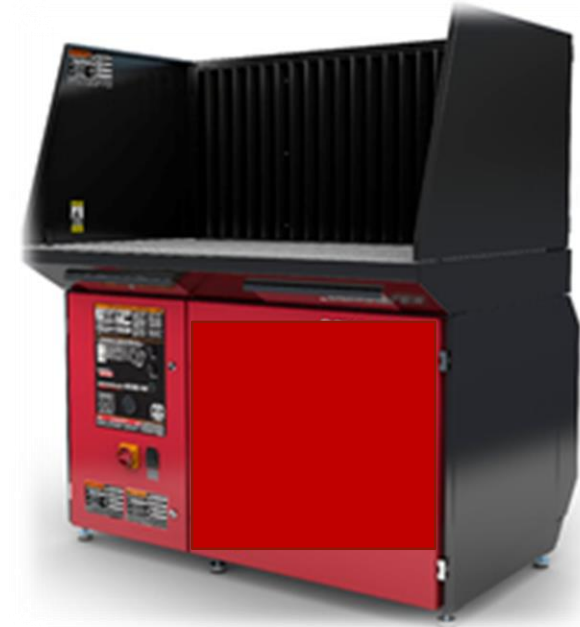
Fixed slot/plenum hood on the work table

-  More effective than a movable hood
-  Sides intended to block cross drafts
-  Welder can weld any location of the weld table capture velocity is the same all across

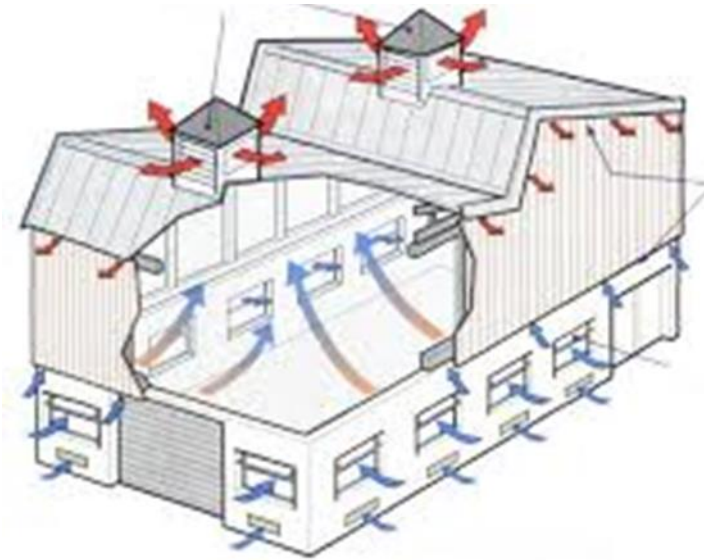


DOWN DRAFT TABLES

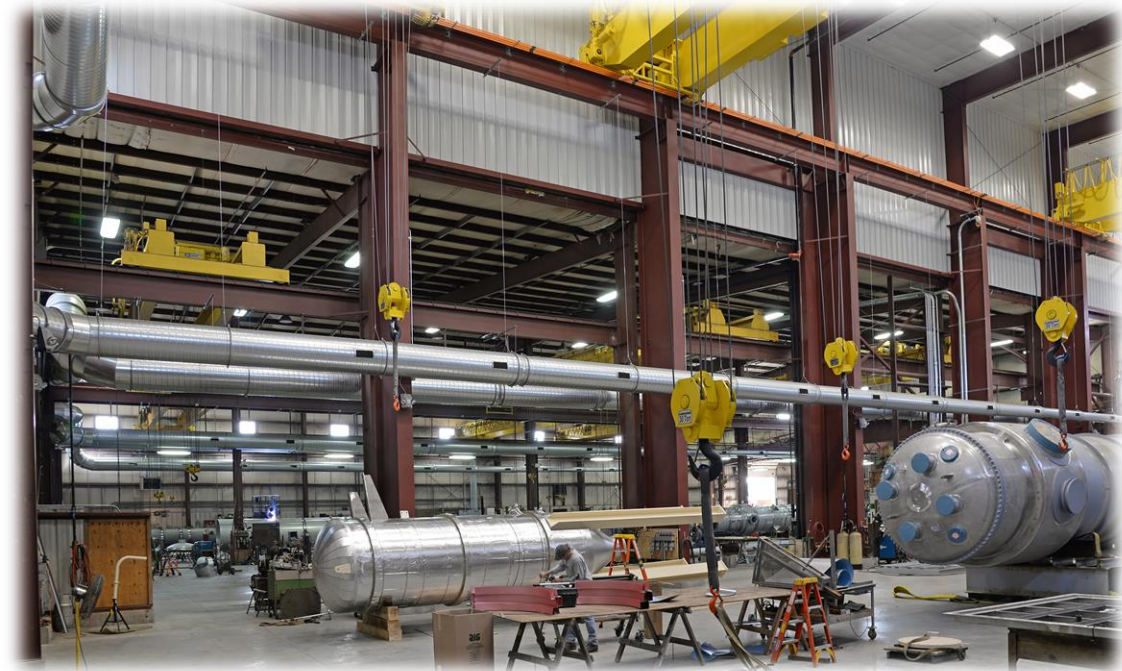
- └ Combination of a welding table, extraction and filtration system
- └ Removal of welding fumes at the source
- └ Comes in various sizes, can be placed in many locations, e.g. inside a welding booth or connected to ductwork
- └ Can be utilized for multiple welders
- └ Down draft tables don't have to be elaborate and can be manufactured in-house



GENERAL DILUTION VENTILATION



- ❑ Dilution ventilation should be used compliment to local ventilation.
- ❑ Used only if contaminants are relatively low
- ❑ Can't have barriers blocking vent flow(min. 7 feet)
- ❑ Used only for short welding periods (air needs time to clear from the fumes)
- ❑ During the generation of moderately toxic contaminants it is recommended to use a respirator



NEW GENERATION OF SAFE WELDING

The school welding shops are set up to ensure proper air quality to improve the future of this important trade.



Collège Boréal

[Request to take pictures of the welders and to use the school Logo](#)



CAMBRIAN
COLLEGE



CONCLUSION

- ✓ The welding environment contains gaseous and particulate complex
- ✓ Hazardous components can cause both acute and chronic health effects
- ✓ Assessing the effectiveness of welding fume extraction is easy
- ✓ Utilizing local ventilation systems or portable welding fume extractors are the most common ways to control welding fumes.
- ✓ Today, special attention is taken by our local colleges to educate our future welders on the importance of proper protection against welding fumes.



QUESTIONS?

