

## 1. OBJECTIVE

This document provides welding fume information and mitigation guidelines for the welding of Austenitic Manganese Steel (AMS) Rail. It is intended as an aid to welding and engineering personnel involved in the fabrication or repair of AMS rail components to fulfill their Occupation Health and Safety responsibilities with respect to control of welding fume.

## 2. ALLOY DESCRIPTION

AMS is widely known as Hadfield steel and is a highly alloyed steel containing 11-14% manganese and approximately 1.2% carbon. Welding consumables for welding, surfacing and weld repairs will contain significant alloying additions of one or more of the following metals; chromium, manganese, molybdenum and nickel. Welding fume generated from such welding will potentially contain particulate containing one or more of these alloying additions plus ozone.

## 3. WORKPLACE AUSTRALIA'S FUME EXPOSURE STANDARDS

The exposure standard for Welding fume is  $5\text{mg}/\text{m}^3$  with the alloying elements that are likely to be encountered in the welding of AMS subject to more stringent controls. Table 1 lists the fume exposure standards for the likely fume constituents and provides advice on potential medical effects as a result of ongoing exposure beyond these limits.

Table 1. Workplace Australia Fume Exposure Standards

Substance	Type	TWA* Mg/m <sup>3</sup>	STEL* Mg/m <sup>3</sup>	Medical Effects
Chromium	Cr(II) & Cr (III) Cr(VI)	0.5 0.05		Toxic, damages respiratory tract, corrosive to skin Carcinogen
Manganese	Mn	1	3	Toxic: tiredness, pneumonia, psychotic behaviour, possible Parkinson's disease like symptoms
Molybdenum	Sol compounds Insol compounds	5 10		Irritant
Nickel	Ni Soluble compounds	1 0.1		Metal fume fever, possible carcinogen
Ozone	O <sub>3</sub>	0.1	0.2	Irritant of respiratory tract & lungs

\*TWA: Time Weighted Average, \*STEL: Short Term Exposure Limit

## 4. FUME GENERATION RATES AND FUME CONTROL REQUIREMENTS WHEN ARC WELDING AND HARDFACING

Fume generation rates have been measured in previous work (reference 1) for a wide range of welding processes and substrates. Results were compared to the allowable exposure standards given in Table 1 and a permissible arc time (PAT) was established for welding in certain cases.

Results of the work provided the following recommendations:

- Structural Steel – fume control is always required when using metal-core consumables or producing butt welds with GMAW. PAT values for other processes varied from 30 to 267 minutes;
- Stainless Steel – fume control is always required when plasma cutting or GMAW welding with higher welding currents. PAT values for MMAW and low current GMAW vary between 30 and 178 minutes. GTAW has no time limit;
- Hardfacing – fume control is always required due to very high fume generation rates;
- Thermit welding of rails – no time limit under normal operating conditions down wind or distant from the weld.

## 5. WORKPLACE ASSESSMENT

State regulations require a workplace assessment to be carried out when dealing with hazardous substances such as welding fume. Section 6 provides advice for welding AMS.

## 6. FUME CONTROL REQUIREMENTS FOR AMS

Fume control will always be required when welding AMS.

### 6.1 Open Workshops and Outdoors

In large open workshops or when outdoors arrange welding to ensure the welder's head is not in the visible welding fume plume. Arrange a cross draft to physically move the welding fume away from the welder's head, Figure 1. This cross draft could be the prevailing wind or an electric fan.

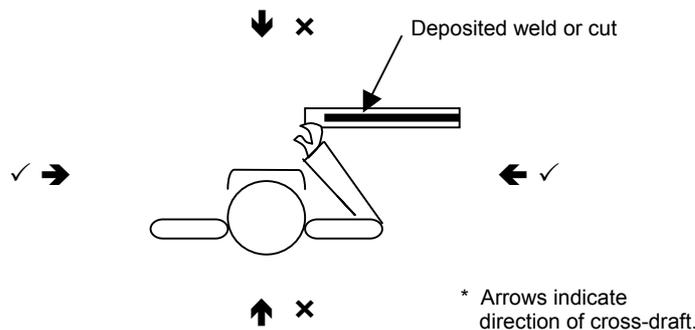


Figure 1. Preferred and non – preferred direction of cross draft for breathing zone ventilation.

### 6.2 Closed Workshops and Indoors

In smaller closed workshops it will be necessary to use purpose built fume extraction equipment for open arc welding. The following controls are available:

- Welding guns with in-built fume extractors (GMAW & FCAW);
- Local fume extraction equipment;
- Welding bays with integrated fume extraction.

For occasional welding activities personal protective equipment PPE is available:

- Air fed welding helmets;
- Respirators.

It should be noted that with PPE there is a greater likelihood of co-workers exceeding the relevant exposure standards unless good general ventilation is implemented.

## 7. REFERENCES

“Assessment of breathing zone fume from a range of welding and related processes” by V Tyagi, D Marinoff & I French CSIRO-MST Open Technical Report: CMST-A-98-15:Project # 96.27

For further details on welding fume and occupational health and safety responsibilities the reader is referred to the WTIA fume minimisation guidelines available @ [www.wtia.com.au](http://www.wtia.com.au).

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<b>NDNP TECHNOLOGY DIFFUSION ACTIVITY # 27</b>	 Welding Technology Institute of Australia ABN 69 003 696 526 <b>NATIONAL DIFFUSION NETWORKS PROJECT TECHNOLOGY QUESTIONNAIRE Rail Group “Welding Fume Mitigation - Manganese Steel Rail”</b>	<b>Document No:</b> 9.4.1QR-0002
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As part of the WTIA National Diffusion Networks Project the Rail Industry Sector has identified the need to apply appropriate fume mitigation controls when welding of austenitic manganese steel (AMS) rail components. The WTIA has prepared a Technical Guidance Note “Welding Fume Mitigation - AMS Rail” that explains the employers obligations, fume exposure limits and fume mitigation measures available when welding AMS rail components. As a valued technology expert in this area we would like you to be part of the Technology Expert Group to review this note. Please complete this questionnaire so that we can gauge the success of meeting this need.

**Objective 1: Identify the need for fume control when welding AMS rail components.**

AMS rail components contain high proportions of manganese which has been the subject of welding fume concerns recently. This guidance note is intended to provide the Rail Industry with advice on mitigating welders exposure to fume during welding. How well does the document achieve these aims?

poor  average  good  very good

Comments: \_\_\_\_\_

**Objective 2: Identify appropriate technology receptors**

This document was written for Maintenance Engineers, Maintenance Contractors, Welding Coordinators, Welders and Occupational Health and Safety personnel in the Rail Industry. Are these people the appropriate individuals we should be targeting?

yes  no

What other types of companies and/or personnel do you suggest we target? \_\_\_\_\_

**Objective 3: Identify current best practice for welding AMS**

The document was written to reflect current best practice for fume control when welding of AMS rail components. Do you envisage opportunities for the use of this practice in industry?

yes  no

If yes, what and where, if no why not? \_\_\_\_\_

**Objective 4: Is the information provided clear, concise and accurate?**

yes  no

If not, why? \_\_\_\_\_

**Objective 5: Broad dissemination of technology to the Rail Industry**

Please indicate how best to disseminate this Technical Guidance Note to the appropriate Industry Recipients

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