NATIONAL SHIPBUILDING RESEARCH PROGRAM
ADVANCED SHIPBUILDING ENTERPRISE
Reducing Naval Ship Construction & Repair Costs

Reduction of Weld Fume Risk in Naval and Commercial Shipyards

NSRP Risk Management Panel Meeting - Seattle, WA
June 22, 2011

Presented By:

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Co-funded by NAVSEA & the U.S. Shipbuilding and Repair Industry with additional support from the Navy Program Executive Offices for Aircraft Carriers, Ships and Submarines.

Reduction of Weld Fume Risk in Naval and Commercial Shipyards

- Introduction and Project Description
- Work Done to Date
- Remaining Action and Schedule
- Questions and Discussion

Reduction of Weld Fume Risk in Naval and Commercial Shipyards

Description:

Project initiated in response to the Notice of Intended Changes (NIC) for the Threshold Limit Value (TLV) for Manganese (Mn) published by the American Conference of Governmental Industrial Hygienists (ACGIH) in 2009

ACGIH proposed a 10-fold reduction in their TLV for Mn to 0.02 mg/m^3 of air over an 8-hour period, defined as the Respirable fraction, and further complicating this limit by requiring new monitoring processes for particle sizes defined as Respirable and Inhalable. Since that time, the new TLV for Mn has remained on the Notice of Intended Changes (NIC) for 2011.

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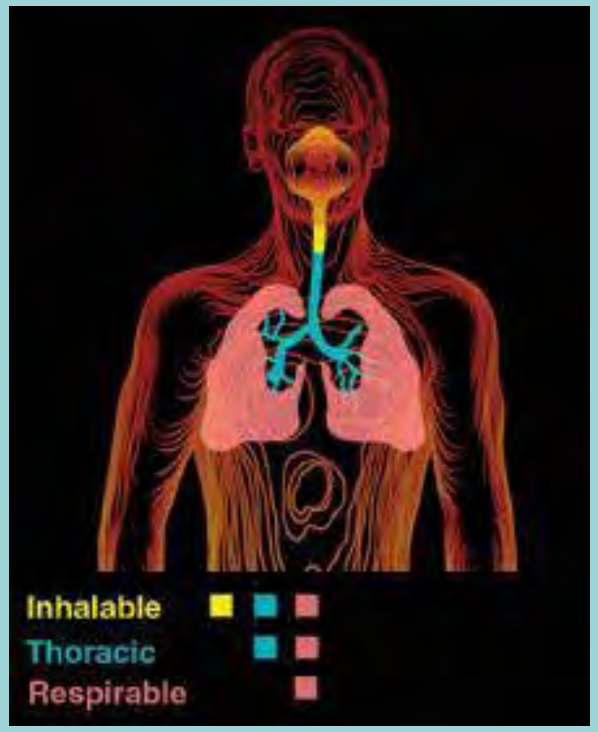
ACGIH recommends that particle-size selective TLV's be expressed in three possible forms:



Inhalable Particulate Mass

Dust particles having a 50% cut-point of 100 µm. These dust particles are hazardous when deposited anywhere in the respiratory tract.

Thoracic Particulate Mass

Dust particles having a 50% cut-point of 10 µm. These dust particles are hazardous when deposited anywhere in the lung airways and gas-exchange regions.

Respirable Particulate Mass

Dust particles having a 50% cut-point of 4 µm. These dust particles are hazardous when deposited anywhere in the gas-exchange regions.

Particle Size-Selective TLV's. (Summary from www.skcinc.com).

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MANGANESE, ELEMENTAL and INORGANIC COMPOUNDS

CAS number: 7439-96-5 (Manganese)

Empirical formula: Mn

TLV–TWA, 0.02 mg/m^3, as Mn, Respirable particulate matter
0.2 mg/m^3, as Mn, Inhalable particulate matter

A4 — Not Classifiable as a Human Carcinogen

TLV® Recommendation

concluded that an eight-hour TWA exposure of approximately 1.0 mg Mn/m^3 (total dust) could lead

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Why Did They Do This?

- TLV Basis - Central Nervous System Impairment (p.2, TLV Documentation)
- Justification is selective and flawed - unknown or inconsistent methods; self-reported symptoms, lack of controls, selection bias.
- NIOSH (Antonini, et.al;) Reports that any link between Mn in welding and movement disorders remains unproven. [“Health Effects of Welding” was published in the journal Critical Reviews in Toxicology, 33(1):61-103 (2003).]
- Santamaria (2007), Fored (2006), Fryzek (2005)
- ACGIH does not provide listing of literature reviewed or available, only literature cited to justify their position.

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What's the Problem?

- Previous testing has always collected "Total" airborne Mn.
- The OSHA PEL for Mn is 5.0mg/m^3 as a Ceiling limit. (Total Mn)
- No validated method to correlate previous testing for "Total" Mn to the newly proposed limits for Respirable and Inhalable Mn, therefore any evaluation to determine compliance will require new air monitoring in accordance with the appropriate methods.
- As a consequence of these changes, the baseline Mn exposure data for welding and other metalworking processes collected at shipyard and previous NSRP studies cannot provide a measure of how much "Respirable" or "Inhalable" Mn may be released.
- Results from preliminary testing confirms that historical "Total" Mn data cannot reliably predict the Inhalable or Respirable Mn found in the welding fume.

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Why should we Care?

- TLV's are not regulations or enforceable standards
- TLV's are not required to be measurable, feasible or achievable
- They are proprietary "expressions of scientific opinion"
- Closed committee of volunteers limited to academic institutions and government agencies
- Manufacturers and businesses cannot participate as TLV committee members
- Initiated in 1940's in the absence of other standards or guidelines
- Since 1970, OSHA and NIOSH continuously research, review and enforce occupational exposure standards
- OSHA and NIOSH now have annual budgets of approximately $1 Billion per year and thousands of full-time employees and dedicated contractors
- Practitioners are unclear what TLV's are, creating confusion and miscommunication
- TLV's can provide the basis for plaintiffs to support claims of injury
- Navy recognizes TLV's as OEL in OPNAVINST 5100.23G, Chapter 16, Part 1603 c.(3)

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What can we do?

- Critically analyze the literature
- Ascertain validity, point out inconsistency
- Perform actual tests
- Establish a basis for action
- Take action
- Inform participating shipyards
- Work for realistic goals

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Project Goals and Objectives:

The goal of this project is to conduct particle-size air sampling for Mn during representative shipyard welding processes in advance of the effective date of this new occupational exposure limit to allow the shipyard industry to evaluate the compliance impact and prepare a practical and focused response.

This project will allow shipbuilding and ship repair activities to:

a) Establish responsive baseline welding exposure data at an early stage to avoid time consuming and costly exposure monitoring at each site where industry-wide representative data will suffice;

b) Allow shipyards to identify potential non-compliance areas early to allow cost-effective and proactive compliance decisions, and

c) Provide the data necessary to prepare and submit a focused and accurate shipyard-industry response where a challenge, rebuttal or alternative proposal is warranted.

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One-year Project (January 2011 – January 2012)

Shipyard Participants:

- BAE Systems – Jacksonville
- Bath Iron Works
- Norfolk Naval Shipyard

Project Prime/Lead; POC:

Atrium Environmental Health and Safety Services; Dan Chute

Participant Subcontractors:

Applied Thermal Sciences, Inc., Navy and Marine Corps Public Health Center

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Task 1: Complete Literature Search and Develop Field Testing Plan

- Finalize project team to include operational breadth (new construction and repair) and technological breadth (existing and emerging welding processes)
- Work with shipyard team to refine project goals and finalize tasking
- Review available literature to take advantage of prior work and avoid duplication
- Define scope and methodology for fume sampling and analysis

Deliverable: Written report summarizing necessary technical background information and defining the field testing plan to be followed in Task 2.

Completed: March 30, 2011

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Task 2: Field Testing and Analysis

- Perform side-by-side fume measurement for Total, Respirable and Inhalable Mn during selected shipyard welding processes, such as SMAW, TIG, FCAW and GMAW-P (pulse-arc)
- Evaluate HLAW as a “Green Shipyard” option for reduced energy consumption, less waste and lower emissions
- Review results to determine need for additional testing in focused areas

Deliverable: Written report summarizing all field testing and evaluations, providing a complete description of methods followed, laboratory analysis and comparison to existing and proposed occupational exposure standards for Manganese.

Completion Date: June 30, 2011

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Task 3: Prepare Draft Report

- Consolidate results with a “snapshot” of existing conditions and results
- Establish recommendations of the team for path to compliance, submittal of comments and any need for future work
- Circulate DRAFT report to the Panel for review and comment

Deliverable: A DRAFT of the final report, for review and comment by participating panel members.

Estimated Completion Date: September 30, 2011

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Task 4: Deliver Final Report

- Deliver a report that documents existing welding methods and exposure profiles, and provides guidelines for implementation of methods to reduce employee and environmental exposure to weld fume in accordance with new occupational exposure limits.

- The data collected and recommendations will be available for use by all shipyards and ship repair activities. Project progress reports will be made to appropriate panels of the NSRP during and at the completion of the project. Reports will be disseminated via “nsrp.org” and other media.

Deliverable: Final written report.

Estimated Completion Date: January 30, 2012

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Work Done To Date:

Task 1: Completed March 30, 2011

1. Technical Summary of the Issue
2. Work Plan and Schedule for Field Monitoring

Task 2: Field Testing and Analysis

1. Testing Completed at 4 sites
2. Report scheduled for delivery June 30, 2011

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Task 1 Findings:

- Is any data available to define the relationship between Total, Inhalable and Respirable Mn in welding fume generated by common ship yard welding processes? NO

  Sources Examined:

  a. Navy NOED Database (3866 air samples for Mn; 1982-2007)
  b. OSHA IMIS Database (1248 samples for Mn fume in Shipyards, 1984-2009)
  c. NIOSH Studies and discussions with researchers, Dr. James Antonini and Dr. Martin Harper.
  d. Review of the ACGIH TLV Documentation for Manganese and Inorganic Compounds (2010)
  e. Discussion and correspondence with ACGIH Chemical Substance Committee Chair, Dr. Terry Gordon and ACGIH Staff Science and Education Manager, Ryan Peltier.
  f. Review of extensive technical literature including previous NSRP studies and research published by the American Welding Society.

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Summary:

1. TLV NIC for Mn (0.02 mg/m^3 of air Respirable fraction, 0.2 mg/m^3 Inhalable fraction) requires totally different air sampling methods from the historical OSHA compliance methods.
2. No valid means of comparison to determine what correlation may be drawn between previous air sampling data for Mn and compliance with the new and drastically lowered occupational exposure limit.
3. No body of data has been identified which has previously studied this relationship, which would allow employers to determine if their previously “compliant” welding operations are operating above or below the new limits.
4. This data gap requires field evaluation to measure exposure and determine what correlation, if any, may exist between historical air sampling data for Total Mn and new air sampling data for Inhalable and Respirable Mn.

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Field Testing Plan – Collect data in three shipyards and one manufacturing facility in order to meet the following objectives:

1. Perform side-by-side fume measurements for Total, Respirable and Inhalable Mn during selected shipyard welding processes, such as SMAW, TIG, FCAW and GMAW.

2. Evaluate Hybrid Laser Arc Welding (HLAW) as a “Green Shipyard” option for reduced energy consumption, less waste and lower emissions.

3. Review results to define patterns and determine if additional testing is recommended.

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Task 2 – Field Testing and Analysis:

- BAE Systems southeast shipyards; April 12-14, 2011
- GD-Bath Iron Works; April 25-27, 2011
- Norfolk Naval Shipyard; May 2-4, 2011
- Applied Thermal Sciences facility (Sanford, ME); June 8-10, 2011

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Collected 96 air samples using “triple-pump” approach

32= Total Mn 32= Inhalable Mn 32= Respirable Mn

7 Metal Working Processes Tested:

- FCAW
- TIG
- SMAW
- MIG-Pulse-Arc
- Carbon Arc Gouging
- Grinding
- HLAW


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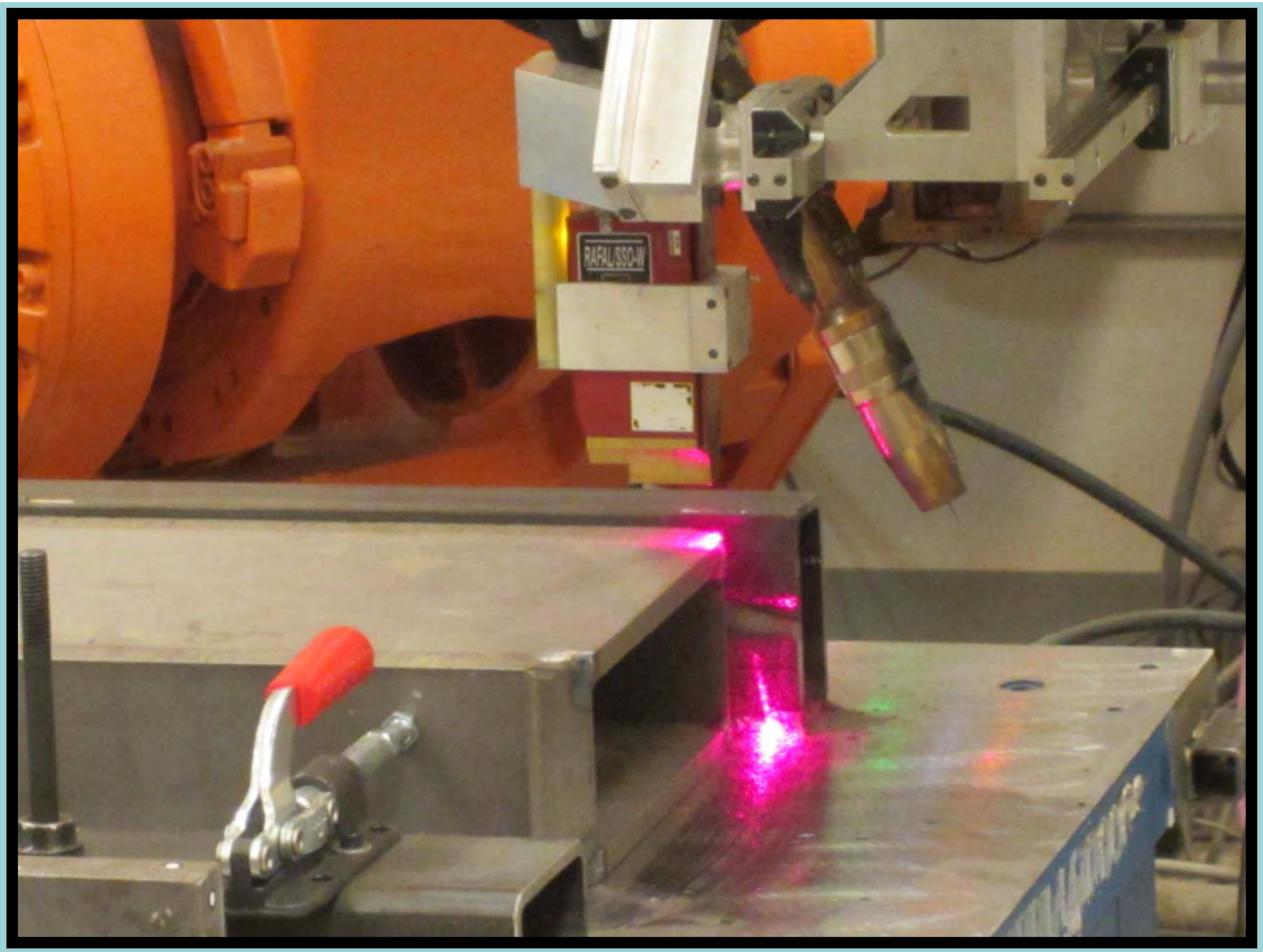
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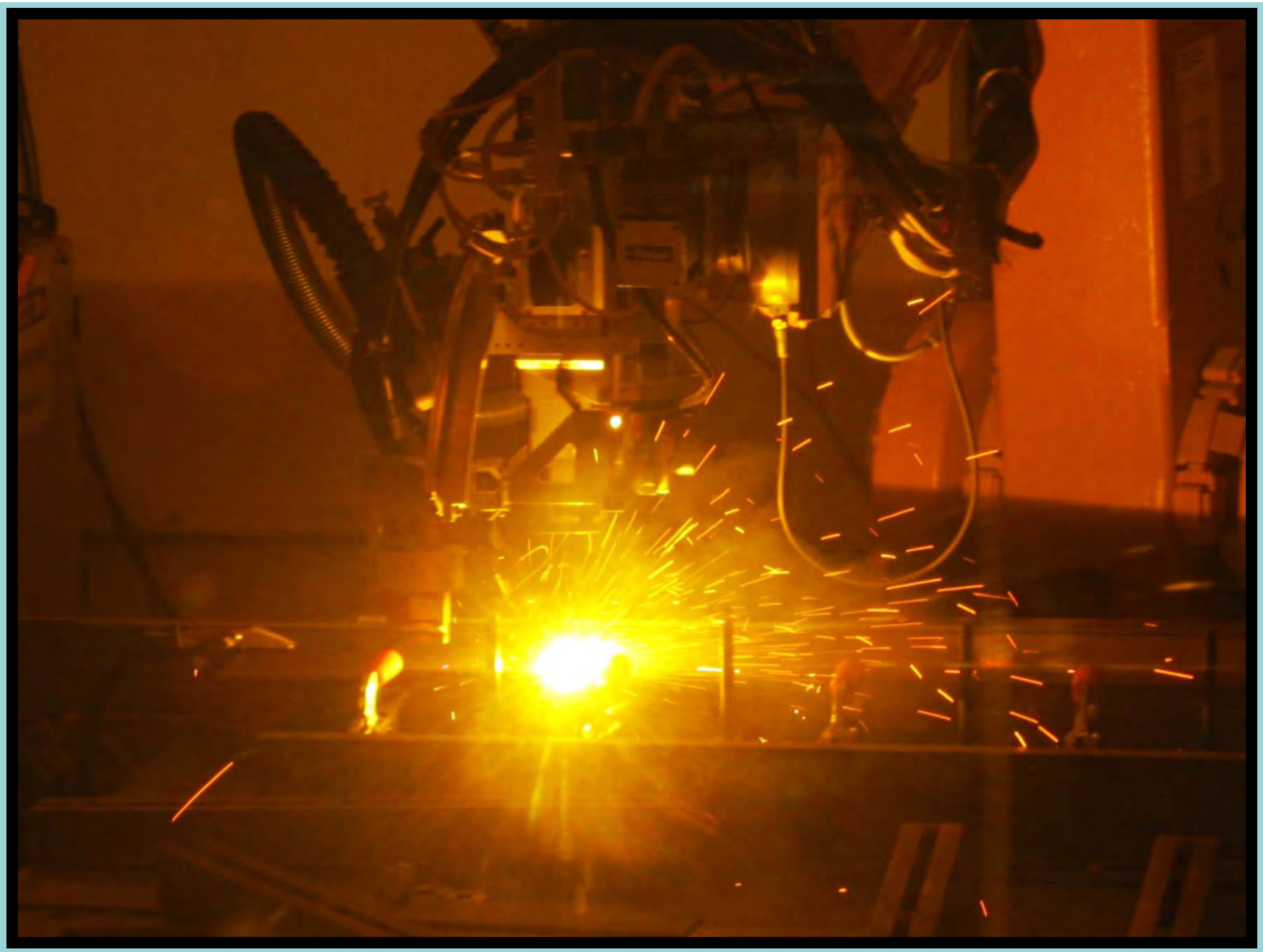
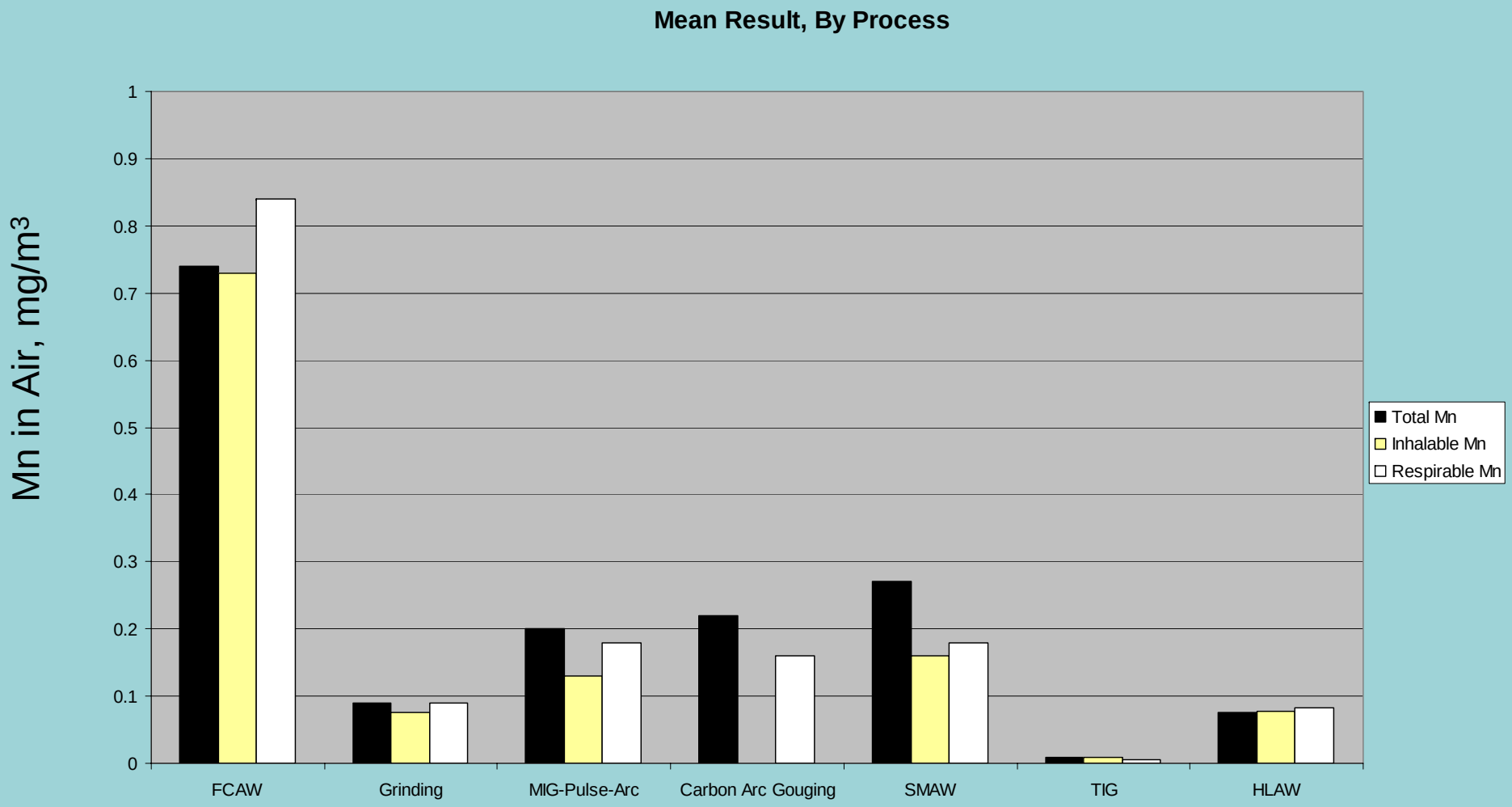


				Total			Inhalable				Respirable			
Total	Total	Process	Sample Type Personal (P) Area (A)	Minutes	Result (Mn, mg/m^3)	8-HR TWA		Minutes	Result (Mn, mg/m^3)	8-HR TWA		Minutes	Result (Mn, mg/m^3)	8-HR TWA
T1	Total(2)	FCAW	P	439	0.60	0.549	Inhal(IM459)	376	0.52	0.407	Resp(21)	–	–	
T2	Total(10)	FCAW	P	x	–	–	Inhal(IM408)	x	–	–	Resp(26)	x	–	
T3	Total(4)	FCAW	A	399	0.41	0.341	Inhal(IM401)	399	0.31	0.258	Resp(24)	398	0.46	0.381
T4	Total(5)	FCAW	A	390	0.58	0.471	Inhal(IM475)	391	0.87	0.709	Resp(13)	391	0.58	0.472
T5	Total(19)	Grinding	P	374	0.23	0.179	Inhal(IM504)	374	0.24	0.187	Resp(17)	272	0.13	*
T6	Total(11)	FCAW	P	368	0.47	0.360	Inhal(IM405)	153	0.52	*	Resp(30)	359	0.49	0.366
T7	Total(7)	Grinding	A	304	0.32	0.203	Inhal(IM385)	303	0.11	0.069	Resp(20)	304	0.30	0.190
T8	Total(16)	FCAW	A	320	0.50	0.333	Inhal(IM076)	320	0.62	0.413	Resp(23)	185	0.40	*
T9	Total(15)	MIG PulseArc	P	466	0.39	0.379	Inhal(IM357)	390	0.37	0.301	Resp(14)	243	0.17	*
T10	Total(11)	MIG/CAG	A	398	0.55	0.456	Inhal(IM332)	303	0.21	0.133	Resp(7)	461	0.68	0.653
T11	Total(4)	Carbon ArcGouging	P	415	0.22	0.190	Inhal(IM478)	x	–	–	Resp(13)	94	0.18	*
T12	Total(3)	MIG/CAG	A	448	0.044	0.041	Inhal(IM435)	448	0.028	0.026	Resp(9)	448	0.037	0.035
T13	Total(10)	MIG PulseArc	P	459	0.013	0.012	Inhal(IM319)	459	0.012	0.011	Resp(L21209-1)	459	0.0082	0.008
T14	Total(TW-1)	MIG PulseArc	A	446	0.0056	0.005	Inhal(IM041)	446	0.0063	0.006	Resp(L21209-13)	446	0.0049	0.005
T15	Total(12)	FCAW	P	173	2.50	*	Inhal(IM422)	90	2.2	*	Resp(L21209-7)	137	3.0	*
T16	Total(5)	FCAW	A	169	0.098	*	Inhal(IM353)	169	0.090	*	Resp(L21209-9)	169	0.083	*
T17	Total(6)	SMAW	P	189	0.86	*	Inhal(IM497)	113	0.41	*	Resp(11)	275	0.53	*
T18	Total(3)	SMAW	A	399	0.033	0.027	Inhal(IM458)	399	0.027	0.022	Resp(23)	399	0.029	0.024
T19	Total(14)	TIG Stainless	P	275	0.027	*	Inhal(IM329)	174	0.022	*	Resp(4)	275	0.011	*
T20	Total(25)	TIG Stainless	A	345	0.0022	0.002	Inhal(IM482	345	0.0026	0.002	Resp(20)	345	0.0020	0.001
T21	Total(17)	SMAW	P	286	0.13	0.077	Inhal(IM512)	286	0.14	*	Resp(21)	286	0.12	*
T22	Total(18)	SMAW	A	390	0.046	*	Inhal(IM372)	390	0.051	0.041	Resp(24)	390	0.043	0.035
T23	Total(7)	TIG Stainless	P	295	0.0060	*	Inhal(IM320)	295	0.0078	*	Resp(8)	295	0.0058	*
T24	Total(22)	TIG Stainless	A	360	0.0015	0.001	Inhal(IM385)	360	0.0015	0.001	Resp(15)	300	0.0013	0.001
T25	Total(13)	HLAW	P	477	0.010		Inhal(IM392)	477	0.0091		Resp(12)	322	0.011	
T26	Total(4)	HLAW	A	477	0.0075		Inhal(IM315)	477	0.0083		Resp(2)	477	0.0076	
T27	Total(5)	HLAW	P	58	0.19		Inhal(IM060)	58	0.20		Resp(3)	58	0.22	
T28	Total(8)	TIG	P	460	0.010		Inhal(IM161)	460	0.010		Resp(1)	460	0.0091	
T29	Total(25)	Grinding	P	360	0.0020		Inhal(IM507)	149	0.0061		Resp(20)	360	0.00048	
T30	Total(22)	Grinding	A	345	0.00084		Inhal(IM041)	345	0.00089		Resp(16)	345	0.00044	
T31	Total(21)	Grinding	P	355	0.0025		Inhal(IM510)	355	0.0066		Resp(23)	355	0.0020	
T32	Total(26)	HLAW	P	110	0.091		Inhal(IM489)	110	0.095		Resp(24)	110	0.091	
*Specific task-related sample. Does not represent an 8-hr TWA														

PRELIMINARY DATA



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Preliminary Observations:

- Relationship between Total, Inhalable and Respirable does not follow any predictable pattern.
- Only TIG did not exceed proposed TLV for Respirable Mn of 0.02 mg/m3.
- Smaller particle size fractions (Inhalable, Respirable) exceeded Total results in many cases. Why?
- Questions raised about variability in application of laboratory test methods, with “cassette wiping.”
- Do the size-fraction test methods really do what they are supposed to? Are they a reliable index of exposure?
- Does this warrant “triple-pumping” at 3X$ to evaluate against an unachievable and unsupportable OEL?
- Does the NIC for the TLV for Mn offer the shipbuilding industry a viable guideline?

Questions and Discussion