



CTC Whitepaper Concept
***Establishment of a Cooperative
Program with U.S. EPA to Revise
Environmental Welding Data***

Environmental Panel Meeting Norfolk, VA

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6/16/2011

NSRP EP Meeting with U.S. EPA (Completed January, 2011)

- Discussed potential of a welding and blasting **major source category** under CAA Section 112 (c)(5)
 - No decision has been made regarding scope, regulatory approach, timeframe, or U.S. EPA point of contact
- Discussed ANPRM Emissions Factors Program Improvements, published in *Federal Register* on October 14, 2009 (74 Fed. Reg. 52723)
 - Projected date for Proposed Rule is July, 2011
 - Outline three primary items:
 1. *Requirement to submit performance test data through Electronic Reporting Tool (ERT)*
 2. *Transition from AP-42 to U.S. EPA's new WebFIRE*
 3. *Revision of current Source Classification Codes (SCCs) assigned to emitting process, such as welding*
- Discovered that NSRP Environmental Panel welding data is currently **incompatible** with U.S. EPA's ERT
 - Not required performance test data
 - No U.S. EPA reference method to sample and analyze for weld fume

U.S. EPA Proposed Opportunity

- Act as first source category to implement revised emissions factors into U.S. EPA's new WebFIRE system
 - WebFIRE will become U.S. EPA's primary collection of emissions factors (anticipated to become active in late 2011 or early 2012)
 - U.S. EPA proposed cooperative project in which NSRP EP team would beta test ERT to incorporate data not directly produced as a result of performance testing
- Update process information in AP-42
 - Welding descriptions
 - SCC
- Submit method used to develop these emissions factors for consideration as "Other Test Method" (OTM), and consideration for development of future authoritative U.S. EPA Reference Method

ALL actions are critical to the potential development of new welding regulations

U.S. EPA Published Welding Information

- AP 42, Fifth Edition, Volume I Chapter 12: Metallurgical Industry
 - 12.19 Electric Arc Welding (January, 1995)
- 1991 Manufacturers Survey - % of electrodes consumed. by process type:
 - Shielded metal arc welding (SMAW) - 45 percent
 - Gas metal arc welding (GMAW) - 34 percent
 - Flux cored arc welding (FCAW) - 17 percent
 - Submerged arc welding (SAW) - 4 percent

Source: USEPA. (1994). *Development of Particulate and Hazardous Emission Factors for Electric Arc Welding (AP-42, Section 12.19)*. Revised Final Report. USEPA Office of Air Quality Planning and Standards Emission Inventory Branch Research Triangle Park, NC 27711. EPA Contract No. 68-D2-0159 Work Assignment No. I-02 MRI Project No. 4601-02.

U.S. EPA Published Welding Information (Contd.)

TABLE 2-1. WELDING PROCESSES FOR ONE BRITISH SHIPYARD²

Welding process	Percentage utilization
Shielded metal arc welding (SMAW)	68.1
Gas tungsten arc welding (GTAW)	13.6
Gas metal arc welding (GMAW)	12.3
Submerged arc welding (SAW)	3.4
Oxyfuel welding	1.3
Atomic hydrogen welding	0.8
Spot welding	0.4
Stub welding	0.2

TABLE 2-2. WELDING PROCESSES FOR ONE MANUFACTURER OF PRESSURE VESSELS³

Welding process	Percentage utilization
Shielded metal arc welding (SMAW)	50
Submerged arc welding (SAW)	25
Flux cored arc welding (FCAW)	20
Gas metal arc welding (GMAW) and gas tungsten arc welding (GTAW)	5

TABLE 2-3. WELDING PROCESSES FOR ONE CALIFORNIA SHIPYARD⁴

Welding process	Percentage utilization
Flux cored arc welding (FCAW)	53.1
Gas tungsten arc welding (GTAW)	27.2
Shielded metal arc welding (SMAW)	17.6
Gas metal arc welding (GMAW)	0.9
Submerged arc welding (SAW)	0.8
Pulse arc welding	0.3
Brazing	0.1

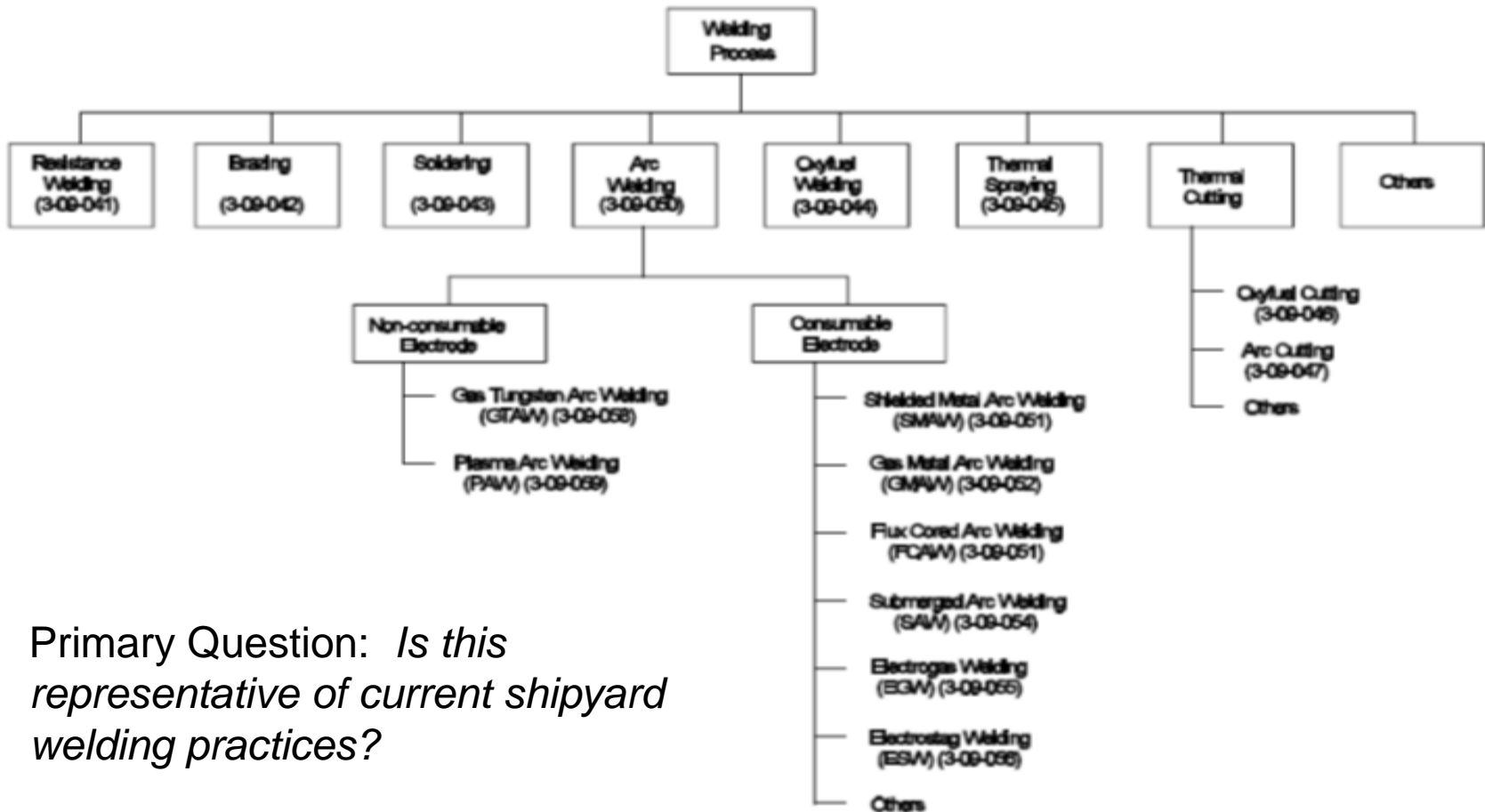
2. B. Irving, "Inverter Power Sources Check Fume Emissions in GMAW," *Welding Journal*, 53-57, February 1992.
3. D. E. Hilton and P. N. Plumridge, "Particulate Fume Generation During GMAW and GTAW," *Welding and Metal Fabrication*, 59:10, 555 & 557-558, December 1991.
4. L. Bauer, "How to Select Exhaust Equipment," *Welding Design and Fabrication*, 64:7, 27-31, July 1991.

Source: USEPA. (1994). *Development of Particulate and Hazardous Emission Factors for Electric Arc Welding (AP-42, Section 12.19)*. Revised Final Report. USEPA Office of Air Quality Planning and Standards Emission Inventory Branch Research Triangle Park, NC 27711. EPA Contract No. 68-D2-0159 Work Assignment No. I-02 MRI Project No. 4601-02.

Current Data

- 16 reporting shipyards (Harris, 2000)
 - FCAW - 64%
 - GMAW -14%
 - SMAW - 10%
 - 85% of shipyard welding is on mild steels.
- 12 reporting shipyards (Serageldin, January 2005)
 - FCAW - 55%
 - SMAW - 29%
 - 90% of rods are mild steel
 - 1% stainless steels are used.
- 5 shipyards (CTC, 2008) electrodes used during a one-year timeframe.
 - FCAW - 77%
 - SMAW - 15%
 - GMAW 7%
 - GTAW - 1%
 - 1% of the welding was done using stainless steel electrodes.

U.S. EPA Published Welding Information



Primary Question: *Is this representative of current shipyard welding practices?*




U.S. EPA Published Welding Emissions Factors - Total Fume

Table 12.19-1 (Metric And English Units). PM-10 EMISSION FACTORS FOR WELDING OPERATIONS^a

Welding Process	Electrode Type (With Last 2 Digits Of SCC)		Total Fume Emission Factor (g/kg [lb/10 ³ lb] Of Electrode Consumed) ^b	EMISSION FACTOR RATING
SMAW ^c (SCC 3-09-051)	14Mn-4Cr	(-04)	81.6	C
	E11018	(-08) ^b	16.4	C
	E308	(-12) ^d	10.8	C
	E310	(-16) ^k	15.1	C
	E316	(-20) ^m	10.0	C
	E410	(-24) ^h	13.2	D
	E6010	(-28)	25.6	B
	E6011	(-32)	38.4	C
	E6012	(-36)	8.0	D
	E6013	(-40)	19.7	B
	E7018	(-44)	18.4	C
	E7024	(-48)	9.2	C
	E7028	(-52)	18.0	C
	E8018	(-56) ^p	17.1	C
	E9015	(-60) ^q	17.0	D
	E9018	(-64) ^r	16.9	C
	ECoCr	(-68) ^t	27.9	C
	ENi-CI	(-72)	18.2	C
	ENiCdBMo	(-76) ^v	11.7	C
	ENi-Cu	(-80) ^u	10.1	C
GMAW ^{d,e} (SCC 3-09-052)	E308L	(-12) ^g	5.4	C
	E705	(-54) ^w	5.2	A
	ER1260	(-10)	20.5	D
	ER5154	(-26)	24.1	D
	ER316	(-20) ^s	3.2	C
	ERNiCdBMo	(-76) ^y	3.9	C
	ERNiCu	(-80) ^z	2.0	C
FCAW ^{d,g} (SCC 3-09-053)	E110	(-06) ^{aa}	20.8	D
	E11018	(-08)	57.0	D
	E308LT	(-12) ^{bb}	9.1	C
	E316LT	(-20) ^{cc}	8.5	B
	E70T	(-54) ^{dd}	15.1	B
	E71T	(-55) ^{ee}	12.2	B
SAW ^f (SCC 3-09-054)	EM12K	(-10) ^{ff}	0.05	C

Source: USEPA.(1995). AP 42, Fifth Edition, Volume I Chapter 12: Metallurgical Industry

U.S. EPA Published Welding Emissions Factors - HAP's

Welding Process	Electrode Type (With Last 2 Digits Of SCC)		HAP Emission Factor (10 ⁻¹ g/kg [10 ⁻¹ lb/10 ³ lb] Of Electrode Consumed) ^b					EMISSION FACTOR RATING	
			Cr	Cr(VI)	Co	Mn	Ni		Pb
SMAW ^c (SCC 3-09-051)	14Mn-4Cr	(-04)	13.9	ND	ND	232	17.1	ND	C
	E11018	(-08) ^a	ND	ND	ND	13.8	ND	ND	C
	E308	(-12) ^j	3.93	3.59	0.01	2.52	0.43	ND	D
	E310	(-16) ^k	25.3	18.8	ND	22.0	1.96	0.24	C
	E316	(-20) ^m	5.22	3.32	ND	5.44	0.55	ND	D
	E410	(-24) ⁿ	ND	ND	ND	6.85	0.14	ND	C
	E6010	(-28)	0.03	0.01	ND	9.91	0.04	ND	B
	E6011	(-32)	0.05	ND	0.01	9.98	0.05	ND	C
	E6012	(-36)	ND	ND	ND	ND	ND	ND	ND
	E6013	(-40)	0.04	ND	< 0.01	9.45	0.02	ND	B
	E7018	(-44)	0.06	ND	< 0.01	10.3	0.02	ND	C
	E7024	(-48)	0.01	ND	ND	6.29	ND	ND	C
	E7028	(-52)	0.13	ND	ND	8.4612	ND	1.62	C
	E8018	(-56) ^p	0.17	ND	ND	0.3	0.51	ND	C
	E9016	(-60)	ND	ND	ND	ND	ND	ND	ND
	E9018	(-64) ^q	2.12	ND	ND	7.83	0.13	ND	C
	ECoCr	(-68)	ND	ND	ND	ND	ND	ND	ND
	ENi-C1	(-72)	ND	ND	ND	0.39	8.90	ND	C
	ENiCrMo	(-76) ^r	4.20	ND	ND	0.43	2.47	ND	C
ENi-Cu-2	(-80) ^s	ND	ND	ND	2.12	4.23	ND	C	
GMAW ^{4a} (SCC 3-09-052)	E308	(-12) ^v	5.24	ND	< 0.01	3.46	1.84	ND	C
	E705	(-54) ^w	0.01	ND	< 0.01	3.18	0.01	ND	A
	ER1260	(-10)	0.04	ND	ND	ND	ND	ND	D
	ER5154	(-26)	0.10	ND	ND	0.34	ND	ND	D
	ER316	(-20) ^y	5.28	0.10	ND	2.45	2.26	ND	D
	ERNiCrMo	(-76) ^z	3.53	ND	ND	0.70	12.5	ND	B
	FRNiCu	(-80) ^{aa}	< 0.01	ND	ND	0.77	4.51	ND	C
FCAW ^{4a} (SCC 3-09-053)	E110	(-06) ^{ab}	0.02	ND	ND	20.2	1.12	ND	D
	E11018	(-08) ^{ac}	9.69	ND	ND	7.04	1.02	ND	C
	E308	(-12)	ND	ND	ND	ND	ND	ND	ND
	E316	(-20) ^{ad}	9.70	1.40	ND	5.90	0.93	ND	B
	E70T	(-54) ^{ae}	0.04	ND	ND	8.91	0.05	ND	B
E71T	(-55) ^{af}	0.02	ND	< 0.01	6.62	0.04	ND	B	
SAW ^a (SCC 3-09-054)	EM12K	(-10)	ND	ND	ND	ND	ND	ND	ND

Source: USEPA.(1995). AP 42, Fifth Edition, Volume I Chapter 12: Metallurgical Industry

Submitting Data to U.S. EPA

- U.S. EPA released, *Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Emissions Factor Database*, as a “Review Draft” in December, 2010.
 - When final it will supersede the previous EPA guidance document for emissions factor development (Procedures for Preparing Emission Factor Documents (EPA-454/R-95-015, November 1997))
- Changes the process for the submission of emissions data to the U.S. EPA significantly.
 - Requires the application of statistical procedures to the data
 - Requires the submission of all data points
 - Relies heavily on SCC codes for data groupings
 - Implements a quantitative process to assign quality ratings

Source: USEPA. (2010). *Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Emissions Factor Database*. Office of Air Quality Planning and Standards Office of Air and Radiation. Research Triangle Park, North Carolina 27711

Data Quality Characterization Procedures

Criteria Area	Review Questions	ERT Scoring	State Reviewer Scoring	
		Points for "Yes"	If "Yes," Add . . .	If "No," Deduct . . .
	Flow diagram of sample recovery	1		
	Flow diagram of sample analysis	1		
	<i>Instrumental Test Methods</i>			
	Stratification checks	6		
	Raw data	6		
	Sampling system flow and temperature logs	6		
	Calibration gas certifications	5		
	Calibration reports	5		
	Complete description of the sampling system	3		
	<i>Process & Facility Operation</i>			
	Process operating parameter data	5		
	Control device operating and monitoring parameter data	5		
	A detailed discussion of the process and control device operation	5		
	Quality Assurance (QA) Review	<i>Manual Test Method QA</i>		
Was the DGM pre-test calibration within the criteria specified by the test method?			1	2
Was the DGM post-test calibration within the criteria specified by the test method?			1	2
Were thermocouple calibrations within method criteria?			1	1
Was pitot inspection acceptable?			1	1
Were nozzle inspections acceptable?			1	1
Were flow meter calibrations acceptable?			1	2
Did the cyclonic flow evaluation show acceptable flow?			1	2
Were the appropriate number and location of sampling points used?		4		
Were pre- and post-test leak checks performed?			2	2
Were leak-checks performed each time the sample port was changed?			1	1
Was the correct procedure used to perform the leak-check?			1	1
Was the entire sampling train leak-checked?			2	2
Did post-test leak checks meet method requirements?			2	3
Did probe and filter temperatures meet method criteria?		5		
Did iso-kinetic sampling rates meet method criteria?		5		
Was the required minimum sample volume collected?	5			
<i>Laboratory QA</i>				
Was the recovery process consistent with the method?		1	2	

Source: USEPA. (2010). *Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Emissions Factor Database*. Office of Air Quality Planning and Standards Office of Air and Radiation. Research Triangle Park, North Carolina 27711

Whitepaper Concept

- **Concept Description:** Establish a collaborative program with the U.S. EPA to update published welding information, and act as the first to implement revised emissions factors into the new WebFIRE system.
- **Project Goals and Objectives:**
 - Goal: Implement revised emissions factors into the new WebFIRE system
 - Objectives:
 - Design a quality rating procedure applicable to data other than source performance testing
 - Prepare existing NSRP EP data according WebFIRE requirements and submit shipbuilding / shiprepair data through the online ERT
 - Review/Revise U.S. EPA's published welding information to ensure it is consistent with the current practices used in the shipbuilding industry

Whitepaper Concept (Contd.)

- **Methods and Procedures Required for Accomplishing Goals and Objectives:**
 - **Subtask 1:** Submit Recommended Revisions for U.S. EPA WebFIRE
 - Attempt to submit NSRP data into WebFIRE system, according to the *Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Emissions Factor Database*
 - Document areas that are incompatible with data not collected from stationary sources
 - Provide recommendations on how to revise these areas to allow the submission of data not collected from stationary sources
 - **Subtask 2:** Submit Recommend Revisions for U.S. EPA Published Welding Information
 - Collect information weld usage data from shipyards and manufacturers (work with NSRP Welding Panel)
 - Compare current usage data to U.S. EPA published information
 - Provide recommendations and suggested revisions
 - **Subtask 3:** Submit the NSRP develop weld fume capture/analysis method for consideration as Other Test Method or U.S. EPA Reference Method

Whitepaper Concept (Contd.)

Previous and Current Work Relationship Flow:

2008: NSRP RA Project *Shipbuilding and Ship Repair Industry Initiative to Prepare for and Comply with the Residual Risk Ruling*

- Identified need for revised emissions factors
- Established the relationship with U.S. EPA

2009: WP Project Entitled *Developing Emissions Factors for Electrodes Commonly used within the Shipbuilding Industry for use in Regulatory Reporting Procedures*

- Generated emissions factors to fill industry / U.S. EPA identified data gaps

2010: Supporting NSRP Shipyards in the Implementation of Recently Generated Emission Factors at the Federal, State, and Local Level

- Opened discussion with U.S. EPA regarding the NSRP's role in how they evaluate/regulate welding
- Provided the opportunity to work with U.S. EPA as part of the Emissions Factors Improvement Process

Whitepaper Concept (Contd.)

- **Deliverables:**

- *Recommended Revisions for U.S. EPA WebFIRE*
- *Recommend Revisions for U.S. EPA Published Welding Information*
- *NSRP Weld Fume Capture/Analysis Reference Method*

- **Benefits and ROI:**

- Demonstrates the industry's commitment to environmental performance by responding to U.S. EPA request for the cooperative program
- Identifies what revisions are necessary to make WebFIRE applicable to emissions factors data *not* collected using a performance test method, which will allow for the development of a tool better suited to exchange data with the U.S. EPA
- Identifies the revisions necessary to ensure U.S. EPA published welding information is consistent with current industry practices, which will be critical in the development of future rulemaking activities
- Provides the industry with the opportunity to have the U.S. EPA accept the NSRP developed method as a recognized method, providing them with the opportunity to conduct future emissions factor research as the needs of the industry change

Whitepaper Concept (Contd.)

- **Technology Transfer Approach:**

- Respond to a direct request from the U.S. EPA to transfer past research into regulatory application
- Establish a sustainable program with the U.S. EPA that can be used for the continual improvement of emissions factors data



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