

## **Shipbuilding and Ship repair –Residual Risk**

### **PROPOSED EMISSION FACTORS FOR**

- STAINLESS STEELS**
- MILD STEELS**
- ALLOYS STEELS**

**Presented during the July 26, 2005 Conference call  
(and the data used for stainless steels and mild steels)**

**August 9, 2005**

**Address comments to:**

**Dr. Mohamed Serageldin  
US EPA  
109 Alexander Drive (59-03)  
RTP, NC 27711**

**[Serageldin.mohamed@epa.gov](mailto:Serageldin.mohamed@epa.gov)**

**Ph. 919-541-2379**

**Fax. 919-541-5689**

## **Overview (7/25/05)**

If you are reading this information for the first time, you will need to download a copy of the attachments presented during the January 25, 2005 shipbuilding and ship repair Industry (stakeholders) meeting (URL. <http://www.epa.gov/ttn/shipb/shipbpg.html>)

You should also print the first ten pages, starting with the Purpose and Objectives.

We revised several emission factors since our last stakeholder meeting on January 25, 2005. The meeting minutes, which we released on July 12, 2005, summarized some of the issues that were raised during the January 2005 by the industry and other stakeholders.

Attachment 1, provides a summary of statistical parameters for stainless electrodes for SMAW, GMAW, and FCAW technologies (processes). The tabular format used for the January meeting (Attachment 8A) was retained. Attachment 2, in this document, provides similar statistical information for mild steels. The changes we made since January 2005 are indicated in the comments section pertaining to each attachment.

Attachment 3 lists the emission factors for the stainless steels and mild steels in Attachments 1 and 2, and the emission factors for alloy steels. This table replaces Table 5 presented during that meeting. We have identified under the “Comment” section in Attachment 3 (cont.) the basis for the proposed emission factors.

M.S.

### **NOTE 1. 08/09/05**

The Data in Attachments 4 through 9 were used for calculating the 95 % Upper Confidence Limit (UCL) of the mean emission factors in Attachments 1 and 2.

M.S.

**Attachment 1:**

**Statistical Analysis of Stainless Steel Emission Factor Data**

**(Proposed Emission Factors)**

### Attachment 1: Statistical Analysis of Stainless Steel Emission Factor Data

Stainless Steel Emission Factors 08-Nov-04 (revised) [last Revised 2/18/05]											
No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info		
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)				
1	Total Chromium	SMAW	E308/E316	0.7413	1.2	14	0.8826	Student's-t			
			E309	0.64	0.86	7	0.8032	Student's-t			
			<b>all data</b>	<b>0.7076</b>	<b>1.2</b>	<b>21</b>	<b>0.8107</b>	<b>Student's-t</b>			
		GMAW	E316	1.032	1.3	3	7.72	Assumed normal distribution			
			E309	4.6	6.51	4	7.607	Mod-t UCL (Adjusted for skewness)			
			<b>all data</b>	<b>3.071</b>	<b>6.51</b>	<b>7</b>	<b>5.82</b>	<b>Bootstrap-t</b>			
		FCAW	E316	2.45	3.04	2	2.999	Assigned UCL for "all data"			
			E309	2.22	2.86	4	3.302	Mod-t UCL (Adjusted for skewness)			
			<b>all data</b>	<b>2.296</b>	<b>3.04</b>	<b>6</b>	<b>2.999</b>	<b>Student's-t</b>			
		2	Hexavalent Chromium	SMAW	E308/E316	0.175	0.353	18	0.1998	Student's-t	<b>0.353 (Outlier)</b> changed 2/9/05
					E309	0.09205	0.163	7	0.1409	Student's-t	
					<b>all data</b>	<b>0.15</b>	<b>0.228</b>	<b>25</b>	<b>0.168</b>	<b>Student's-t</b>	
GMAW	E308/E316			0.02153	0.0497	13	0.02843	Student's-t			
	E309			0.04752	0.06649	4	0.0801	Student's-t			
	<b>all data</b>			<b>0.02765</b>	<b>0.0665</b>	<b>17</b>	<b>0.03922</b>	<b>Approx. Gamma</b>			
FCAW	E316			0.05587	0.0707	3	0.1049	Assumed normal distribution			
	E309			0.03122	0.122	10	0.07627	95% Chebyshev (Meand, Sd)	<b>0.122 (Outlier)</b> changed 2/9/05		
	<b>all data</b>			<b>0.0306</b>	<b>0.0707</b>	<b>13</b>	<b>0.0593</b>	<b>95% Chebyshev (Meand, Sd)</b>			

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info	
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)			
3	Manganese	SMAW	E308/E316	0.5005	0.861	14	0.6132	Approx. Gamma		
			E309	0.3795	0.59	7	0.4569	Student's-t		
			<b>all data</b>	<b>0.4602</b>	<b>0.861</b>	<b>21</b>	<b>0.534</b>	<b>Approx. Gamma</b>		
			GMAW	E316	2.987	3.52	3	4.134	Assumed normal distribution	
				E309	11.13	17.9	4	19.84	Student's-t	
				<b>all data (Default)</b>	7.64	17.9	7	12.64	Student's-t	
							<b>0.309</b>	used fume composition curves (from reference data) and max fume formation rates from AP-42 as default	See Note 10.	
		FCAW	E316	25.85	28.5	2				
			E309	6.625		4	8.919	mod-tUCL (adjusted for skewness)		
			<b>all data (Default)</b>	10.35	28.5	6	18.3	Student's-t		
							<b>0.521</b>	used fume composition curves (from reference data) and max fume formation rates from AP-42 as default	See Note 11.	
		4	Nickel	SMAW	E308/E316	0.00963	0.228	14	0.1314	Approx. Gamma
E309	0.05689				0.653	6	0.06423	Student's-t		
<b>all data</b>	<b>0.07953</b>				<b>0.2278</b>	<b>20</b>	<b>0.1041</b>	<b>Student's-t (ESAB data for E309L was removed)</b>		
GMAW	E316			77.3	94.4	3		Calculated 95%UCL = unfeasable result;		
	E309			402.7	705	3		used fume composition curves (from reference data)		
	<b>all data (Default)</b>			<b>705</b>	<b>705</b>	<b>6</b>	<b>0.306</b>	and max fume formation rates from AP-42 as default	See Note 12.	
FCAW	E316			190	221	2		Calculated 95%UCL = unfeasable result;		

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
			E309	77.66	112	4		used fume composition curves (from reference data) and max fume formation rates from AP-42 as default	See Note 13.
			<b>all data</b>	<b>(Default)</b>	<b>221</b>	<b>6</b>	<b>0.516</b>		

NOTE Level of nickel in E308, E309, E310, and E316 welding rods/wires can vary between 9 to 21 % by mass

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
								<b>Using same default value for all rods/processes.</b>	<b>See Note 14.</b>
5	Lead	SMAW	E308/E316	0.00963	0.0319	13	0.01337	Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	
			E309	0.00705	0.0089	6	0.008065		
			<b>all data</b>	0.00882	0.0319	19	<b>0.215</b>		
		GMAW	E316	ND	ND	0		Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	
			E309		0.0613	1	0.0613		
			<b>all data</b>		0.0613	1	<b>0.215</b>		
		FCAW	E316	ND	ND	0		Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	
			E309	0.0639	0.064	2	0.064		
			<b>all data</b>		0.064	2	<b>0.215</b>		

ND = not determined

NOTES: 11-Nov-04 Revised **Re-Revised 2/18/05**

1. Single data points were used for determining the 95% UCL.

2. Q-Q plot was used to test for the appropriate parametric distribution (normal, lognormal, and Gamma), otherwise a non-parametric method was selected. Percentile bootstrap, bootstrap-t., and H-UCL were compared with the recommended value.

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
3.									Individual Cr(6) data points received from the California Air Resource Board in August '04 were included. (In June '04 CARB report - only provided the average values and the S.D .)
4.									We assumed that we could combine E308 and E316 since the rods are only used to weld s.s substrates, and the individual EF values overlapped. We analyzed E309 separately because these rods can also be used to weld stainless steel to mild steel. The substrate welded can contribute metals to the fumes.
5.									We then combiné the data for all the rods in a process when the statistical analysis did not indicate otherwise: (1) The QQplots for the combined data for Total Cr, Cr(6), and Mn indicated that the combined data "all data" followed a distribution that is similar to that of the the individual rod groupings, i.e., E308/E316 and E309.
6.									When there were only 3 data points, we assumed the data came from a normal population to calculate a UCL. This UCL would tend to be on the protective side, because of the small data set.
7.									Some of the emission factors were unusually high, e.g., ESAB's EF for Ni (SMAW/E309L). There are no AP-42 values for SMAW/E309.
8.									We assigned default values when there were data gaps or inconsistencies.
9.									Cr, Cr(6), and Mn are the 3 important metals in the welding fumes for RR purposes.
10.									Recent (02/05) industry supplied data showed Mn avg (rod content) = 1.59% = 15.9 g/kg --> therefore, literature data used for 95% UCL of mean unre <b>(Welding rod composition data included as attachments to e-mail from V. Dickinson, BIW, to M. Serageldin, EPA, dated 2-4-05.)</b> Pad testing data from shipyards shows same percentages for Mn in the actual welds. Used same default approach as used for Ni factors. Average Mn content = 1.59% --> 5.72% Mn in fume: (FGR for GMAW/stainless steels = 5.4 g/kg) x (5.72/100) = 0.309 g/kg g/kg. [Default approach based on AP-42 Table 4-15 (candidate PM/FGR emission factor) and Reference 11 (metal content in fume)].
11.									See Note 10. --> Industry supplied data showed Mn avg (rod content) = 1.59% = 15.9 g/kg --> therefore, literature data used for 95% UCL of mean un Pad testing data from shipyards shows same percentages for Mn in the actual welds. Used same default approach as used for Ni factors.

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Other Info
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
				Average Mn content = 1.59% --> 5.72% Mn in fume: (FGR for FCAW/stainless steels = 9.1 g/kg) x (5.72/100) = 0.521 g/kg.					
12.				Industry supplied data showed Ni avg (rod content) ranges from 9 - 21 % = 90 - 210 g/kg --> therefore, literature data used for 95% UCL of mean unre Pad testing data from shipyards shows same percentages for Ni in the actual welds. Default approach based on AP-42 Table 4-15 & Reference 11. Maximum Ni content = 21% --> 5.67% Ni in fume: (FGR for GMAW/stainless steels = 5.4 g/kg) x (5.67/100) = 0.306 g/kg.					
13.				Industry supplied data showed Ni avg (rod content) ranges from 9 - 21% = 90 - 210 g/kg --> therefore, literature data used for 95% UCL of mean unre Pad testing data from shipyards shows same percentages for Ni in the actual welds. Default approach based on AP-42 Table 4-15 & Reference 11. Maximum Ni content = 21% --> 5.67% Ni in fume: (FGR for FCAW/stainless steels = 9.1 g/kg) x (5.67/100) = 0.516 g/kg.					
14.				Need REAG to verify lead emissions are not a risk issue at this level.					



**Attachment 2.**

**Statistical Analysis of Mild Steel Emission Factor Data**

**(Proposed Emission Factors)**

## Attachment 2. Statistical Analysis of Mild Steel Emission Factor Data

Mild Steel Emission Factors 11-Nov-04 (Revised) [Last Revised 07/25/05]

No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	Related Info.
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
1	Total Chromium	SMAW	E7018/28	0.0109	0.0117	2	Assigned "old" default value based on SS value and ratio of total Cr in mild steel to SS: (0.8826 g/kg) x (0.5%/20%) = 0.02 g/kg <b>0.0117</b>	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX. <b>See Note 9.</b>	
			E11018	ND	ND	0			
			all data (Default)			2			0.02206
		GMAW	E70S(3to6)	0.00228	0.00378	3	Assign max. value of all data <b>0.0801</b>		
E70S(6)	0.0719	0.0801	2						
all data (Default)			5	0.0801	<b>0.0801</b>	<b>See Note 10.</b>			
2	Hexavalent Chromium	FCAW	E70T/E71T	0.00307	0.0345	40	95% Chebyshev [Mean S.D]	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX. <b>See Notes 5 and 9.</b>	
			E71M			3	(4.10E-01 g/kg was excluded)		
		(TM770) E71T-1M			3				
		all 5 data pts	0.0416	0.0624	5	0.05939	Based on Student's t test		
2	Hexavalent Chromium	SMAW	E7018/28	ND	ND	0	Default: 55% of Total Cr (0.022 g/kg) = 0.012 <b>0.0037</b> Default: 55% of Total Cr (0.0067 g/kg) = 0.0037	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX. <b>See Notes 5 and 9.</b>	
			E11018	ND	ND	0			
			all data (Default)			0			0.0121
		GMAW	E70S (3to6)	ND	ND	0	Default: 5% of Total Cr (0.0801 g/kg) = 0.004 <b>0.0003</b> Default: 5% of Total Cr (0.0067 g/kg) = 0.00033		
E70S-6		0.0041	1						
all data (Default)			1	0.004	<b>0.0003</b>	<b>See Notes 5 and 10.</b>			
2	Hexavalent Chromium	FCAW	E70T/E71T	ND	ND	0	Default = 10% of Total Cr (0.0067 g/kg) = 0.0007	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX. <b>See Notes 5 and 10.</b>	
			E71M	0.02666	0.05082	3			
		(TM770) E71T-1M	0.00255	0.00265	2	0.03356	Adj-CLT UCL (Adjusted for skewness)		
		all 5 data points (Default)			5	0.0059	Default: 10% of Total Cr (0.05939) = 0.00594 <b>0.0059</b>		<b>See Note 5.</b>

Mild Steel Emission Factors Tabulated on 28-Oct-04 (Revised) [Re-Revised 2/18/05]									
No.	Metal in Fumes	Welding Process	Rod Type	Statistics				Comments	
				Mean (g/kg)	Maximum (g/kg)	Sample Size	95% UCL (g/kg)		
3	Manganese AP-42	SMAW	E7018/28	0.9972	1.72	9	1.216	Approx. Gamma <b>(2.117 identified as outlier based on Box Plot)</b> Approx. Gamma	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX.
			E11018	1.34	2.117	5	1.876		
			<b>all data</b>	<b>1.04</b>	<b>1.72</b>	<b>14</b>	<b>1.18</b>		
		GMAW	E70S (3to6)	0.3629	0.8216	19	0.3963	Approx. Gamma (Mn in welding rod is less than 2% by mass) Default based on E70S with 19 data points.	Grouping includes all 70S electrodes w/ 2 mil specs. (see Mn calculation)
			E70S-6	10.41	12.8	2	<b>0.3963</b>		
		FCAW	E70T/E71T	0.8577	2.68	62	<b>0.9854</b>	Student's-t  Mn can vary from .01 to 13.5 % by mass of rod.	
				E71M	17.6	21.8	2		
			(TM770) E71T-1M	25.63	32.6	3			
			E71M/-1M (Default)	22.42	32.6	5	28.98 <b>0.9854</b>	Student's-t (Do not use UCL) Default based on FCAW/E70T/E71T data	
		4	Nickel	SMAW	E7018/28	ND	ND	0	
E11018	ND				ND	0			
<b>all data</b>							<b>0.03707</b>	Default based on FCAW/E70T/E71T data (See Note 11.)	
GMAW	E70S (3to6)				0.000619	1		Grouping includes all 70S electrodes w/ 2 mil specs. (see Mn calculation)	
	E70S-6			ND	ND	0			
FCAW	E70T/E71T			0.01001	0.092	43	<b>0.03707</b>	99% Chebyshev (Mean, S.D)	
				E71M		1.99	3		
	(TM770) E71T-1M					12	3	Two data points had "0.00" values (non detect). (Ni can vary from .01 to 10 % by mass of rod)	<b>Data for TM-771 show 0.43 &amp; 0.02%</b>
	<b>all data</b>				<b>0.03707</b>	Default based on FCAW/E70T/E71T data			

ND = Not Determined

Mild Steel Emission Factors Tabulated on 28-Oct-04 (Revised) [Re-Revised 2/18/05]									
No.	Metal in Fumes	Welding Process	Rod Type	Statistics			95% UCL (g/kg)	Comments	
				Mean (g/kg)	Maximum (g/kg)	Sample Size			
5	Lead	SMAW	E7018/28	1.6E-05	1.67E-05	2	<b>0.215</b>	Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	Grouping includes 60XX, 70XX, 80XX, 90XX, 100XX, 110XX.
			E11018	ND	ND	0			
			<b>all data</b>						
		GMAW	E70S (3to6)	ND	ND	0	<b>0.215</b>	Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	Grouping includes all 70S electrodes w/ 2 mil specs.
			E70S-6	0.141	0.215	2			
		FCAW (TM770)	E70T/E71T	ND	ND	0	<b>0.215</b>	Lead is a trace contaminant in carbon steels; used default value for 95%UCL = maximum data reported for any mild steel or SS = 0.215 g/kg	?? MSDS did not report lead.
			E71M	0.0489	0.052	3			
			E71T-1M	0.0597	0.0988	6			

ND = Not Determined

NOTES: 11/11/2004 Revised [Re-Revised 2/18/05] >>7/25/05 M.S

1. Single data points were used for determining the 95% UCL for GMAW and FCAW. The mild steel data for SMAW were mostly averages of six runs each.
2. Q-Q plot was used to test for the appropriate parametric distribution (normal, lognormal, and Gamma), otherwise a non-parametric method was selected. Percentile bootstrap, bootstrap-t., and H-UCL were compared with the recommended values.
3. We combined some of the rods/wires within a process when the metal compositions in the original rod/wire were similar.
4. Lead was not reported for mild steel by the shipyards in response to EPA's 2003 questionnaire.
5. We assigned default values when there were data gaps or inconsistencies. We used Cr(6)/total Cr ratio

to determine the amount of Cr(6). The ratio was 55% for SMAW; 5% for GMAW, and 8 % for FCAW. These ratios are average numbers based on the literature.

6. Some of the emission factors were unusually high, as in the case of Mn and Ni.

7. Cr, Cr(6), and Mn are 3 important metals in the welding fumes in so far as RR risk is concerned.

8. In the NSRP 0587 report, the emission factor for Ni (g/kg) was twice indicated as being "0.0" for FCAW/E71-M.

9. Some of the industry data showed Cr content = 0.03%, 0.06% for 7018 and 0.02% for 9018 and 12018. 8018 has 1.18% Cr.

Mil spec requirements: 7018 = <0.15%; 8018 = 1.0 - 1.5%; 9018 = 0.15%; 10018 = 0.40%; 11018 = 0.4%; and 1208 = 0.65%.

**(Welding rod composition data included as attachments to e-mail from V. Dickinson, BIW, to M. Serageldin, EPA, dated 2-4-05.)**

We decided to use the maximum value in each case as the default.

[SMAW/7018/24 accounts for 80% of total usage for this grouping of electrodes.]

10. Recent data supplied by industry data showed that the Cr content of various E70S rods = 0.08% and mil specs = <0.15%.

**(Welding rod composition data included as attachments to e-mail from V. Dickinson, BIW, to M. Serageldin, EPA, dated 2-4-05.)**

We used the maximum value of all the data (0.0801 g/kg). This value fall within the range of FCAW values.

11. Very limited data for nickel - decided to use FCAW/E70/E71T data based on 43 datapoints for all mild steel welding processes.

12. Need REAG to verify lead emissions are not a risk issue at this level.

### **Attachment 3.**

#### **Summary of Proposed Welding Emission Factors for**

- 1. Stainless Steels**
- 2. Mild Steels**
- 3. Alloy Steels**

### Attachment 3. Summary of Welding Emission Factors<sup>1</sup>

**Summary of Welding Information - by welding process and type of electrode--**  
compiled on 11-22-04. (Last Revised 2/26/05). Summary includes data from 12 shipyards  
(Newport News Shipyard data is CBI) for baseline year - 1999. Welding Rod/Wire  
Consumption = Annual Usage - Waste

Welding Process	Type of Electrode	Proposed Emission Factors (using 95% UCL)				
		Total Cr, g/kg	Cr+6, g/kg	Mn, g/kg	Ni, g/kg	Pb, g/kg
SMAW	E308	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E309	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E310	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E316	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E347	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E429	8.11E-01	1.68E-01	5.34E-01	1.04E-01	2.15E-01
SMAW	E6010	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E6011	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E6013	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E7018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E7024	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E70/30	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E8018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E9018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E10018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E11018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E9N10	6.01E-02	3.30E-02	1.91E+00	1.72E+00	2.15E-01
SMAW	E1N12	2.71E+00	1.49E+00	3.50E+00	1.83E+00	2.15E-01
SMAW	E8N12	1.75E+00	9.60E-01	2.83E+00	1.69E+00	2.15E-01
SMAW	ENiCl	6.01E-02	3.30E-02	1.22E-02	1.60E+00	2.15E-01
SMAW	Nickel 61	6.01E-02	3.30E-02	1.22E-02	1.67E+00	2.15E-01
SMAW	Ni-Rod 99X	6.01E-02	3.30E-02	1.22E-02	2.02E+00	2.15E-01
SMAW	ED029203	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	RN60	6.01E-02	3.30E-02	1.91E+00	1.73E+00	2.15E-01
SMAW	KOBESUS-43	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	MIL 67	6.01E-02	3.30E-02	7.61E-01	1.23E+00	2.15E-01
SMAW	Arc Rod	6.01E-02	3.30E-02	3.50E+00	1.44E-02	2.15E-01
SMAW	187N	6.01E-02	3.30E-02	1.91E+00	1.73E+00	2.15E-01
SMAW	BCUP 5	6.01E-02	3.30E-02	1.91E+00	1.73E+00	2.15E-01
SMAW	E2209	6.01E-02	3.30E-02	3.50E+00	7.00E-01	2.15E-01
SMAW	E4043	6.01E-02	3.30E-02	3.50E+00	7.00E-01	2.15E-01
SMAW	E5556	6.67E-03	3.70E-03	1.61E+00	1.92E-01	2.15E-01
SMAW	E70S	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E80S	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	ECuSn	6.01E-02	3.30E-02	1.91E+00	1.72E+00	2.15E-01

<sup>1</sup> Stainless Steels, Mild Steels, and Alloy Steels

Welding Process	Type of Electrode	Proposed Emission Factors (using 95% UCL)				
		Total Cr, g/kg	Cr+6, g/kg	Mn, g/kg	Ni, g/kg	Pb, g/kg
SMAW	E12018	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	E7028	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	LIN-L70	6.67E-03	3.70E-03	1.18E+00	3.71E-02	2.15E-01
SMAW	EIA2A	2.17E-02	1.19E-02	8.61E-01	1.44E-02	2.15E-01
GMAW	E308	5.82E+00	3.92E-02	3.09E-01	3.06E-01	2.15E-01
GMAW	E309	5.82E+00	3.92E-02	3.09E-01	3.06E-01	2.15E-01
GMAW	E310	5.82E+00	3.92E-02	3.09E-01	3.06E-01	2.15E-01
GMAW	E316	5.82E+00	3.92E-02	3.09E-01	3.06E-01	2.15E-01
GMAW	E347	5.82E+00	3.92E-02	3.09E-01	3.06E-01	2.15E-01
GMAW	(LC 33) HD/Face (FC)	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	Arc Rod	1.29E-02	6.44E-04	7.51E-01	3.08E-03	2.15E-01
GMAW	BCUP 5	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	ECuSn	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	DS7100	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E100	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E10018	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E110	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E11018	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E2209	3.74E-01	1.87E-02	7.51E-01	1.50E-01	2.15E-01
GMAW	E4043	1.29E-03	6.44E-05	7.51E-01	0.00E+00	2.15E-01
GMAW	E5356	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E5556	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E70S	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E7018	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E80S	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E8018	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E8N12	3.74E-01	1.87E-02	6.06E-01	3.62E-01	2.15E-01
GMAW	E9018	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	E9N10	7.80E-04	3.90E-05	4.09E-01	3.68E-01	2.15E-01
GMAW	EB1	6.67E-03	3.00E-04	3.96E-01	3.71E-02	2.15E-01
GMAW	ECu	1.37E-02	6.83E-04	5.92E-01	1.93E-01	2.15E-01
GMAW	ECuAl	7.80E-04	3.90E-05	9.94E-02	1.26E-02	2.15E-01
GMAW	ECuNi	4.37E-02	2.18E-03	2.33E-01	2.68E-01	2.15E-01
GMAW	ECuNiAl	2.57E-02	1.29E-03	2.62E-03	1.93E-01	2.15E-01
GMAW	ECuSi	2.57E-02	1.29E-03	0.00E+00	1.93E-01	2.15E-01
GMAW	ECuSn	1.29E-02	6.44E-04	3.08E-01	3.08E-03	2.15E-01
GMAW	ECuZn	1.29E-02	6.44E-04	5.66E-02	3.08E-03	2.15E-01
GMAW	EN60	1.29E-02	6.44E-04	4.09E-01	3.68E-01	2.15E-01
GMAW	EN625IN	1.29E-02	6.44E-04	2.62E-03	3.08E-03	2.15E-01
GMAW	EN67	1.29E-02	6.44E-04	4.09E-01	3.68E-01	2.15E-01
GMAW	ENi	1.29E-02	6.44E-04	2.62E-03	4.29E-01	2.15E-01
GMAW	ENiCrFe	4.25E-01	2.13E-02	3.75E-01	3.89E-01	2.15E-01
GMAW	ENiCu	1.29E-02	6.44E-04	2.33E-01	3.74E-01	2.15E-01
GMAW	METALLIZING	1.29E-02	6.44E-04	2.62E-03	3.08E-03	2.15E-01



Welding Process	Type of Electrode	Proposed Emission Factors (using 95% UCL)				
		Total Cr, g/kg	Cr+6, g/kg	Mn, g/kg	Ni, g/kg	Pb, g/kg
GMAW	MIL 67	1.29E-02	6.44E-04	1.63E-01	2.82E-01	2.15E-01
GMAW	Ni-Rod 55	1.29E-02	6.44E-04	3.01E-01	4.09E-01	2.15E-01
GMAW	RN60	1.29E-02	6.44E-04	4.09E-01	3.77E-01	2.15E-01
GMAW	RN625	5.80E-01	2.90E-02	2.62E-03	3.56E-01	2.15E-01
GMAW	RN67	1.29E-02	6.44E-04	1.63E-01	2.70E-01	2.15E-01
GMAW	RN82	5.03E-01	2.51E-02	4.09E-01	3.68E-01	2.15E-01
GMAW	WELDING	6.67E-03	3.30E-04	3.96E-01	3.71E-02	2.15E-01
FCAW	E308	3.00E+00	5.93E-02	5.21E-01	5.16E-01	2.15E-01
FCAW	E309	3.00E+00	5.93E-02	5.21E-01	5.16E-01	2.15E-01
FCAW	E316	3.00E+00	5.93E-02	5.21E-01	5.16E-01	2.15E-01
FCAW	E347	3.00E+00	5.93E-02	5.21E-01	5.16E-01	2.15E-01
FCAW	MIL101TC	1.20E-02	1.20E-03	9.55E-01	2.04E-01	2.15E-01
FCAW	E101	6.67E-03	7.00E-04	9.85E-01	3.71E-02	2.15E-01
FCAW	E120S	1.52E-01	1.52E-02	9.55E-01	2.04E-01	2.15E-01
FCAW	E70S/T	6.70E-03	7.00E-04	9.85E-01	3.71E-02	2.15E-01
FCAW	E71T	6.70E-03	7.00E-04	9.85E-01	3.71E-02	2.15E-01
FCAW	TM771	5.94E-02	5.90E-03	9.85E-01	3.71E-02	2.15E-01
FCAW	E80S/T	5.94E-02	5.90E-03	9.85E-01	3.71E-02	2.15E-01
FCAW	E81T	5.94E-02	5.90E-03	9.85E-01	3.71E-02	2.15E-01
FCAW	E8AT	5.94E-02	5.90E-03	9.85E-01	3.71E-02	2.15E-01
FCAW	EM12K	5.94E-02	5.90E-03	9.85E-01	3.71E-02	2.15E-01
SAW	EL12 (L-60)	1.65E-05	8.25E-07	1.27E-03	2.50E-05	2.15E-01
SAW	EM12K	1.65E-04	8.25E-06	2.09E-03	1.62E-04	2.15E-01
SAW	ENi	3.30E-04	1.65E-05	3.35E-05	5.40E-03	2.15E-01
SAW	Flux F72	1.65E-05	8.25E-07	1.55E-02	2.50E-05	2.15E-01
SAW	SP/Arc 86	3.30E-04	1.65E-05	5.00E-06	5.00E-06	2.15E-01
SAW	WM1093	3.30E-05	1.65E-06	5.00E-06	5.00E-06	2.15E-01
SAW	KOBESUS-43	1.32E-04	6.60E-06	1.74E-03	1.50E-05	2.15E-01
SAW	LIN-L70 (AWS EA1)	1.65E-05	8.25E-07	1.90E-03	5.00E-06	2.15E-01
SAW	WM1095	3.30E-05	1.65E-06	5.00E-06	5.00E-06	2.15E-01
MISC	Carbons	1.65E-05	8.25E-07	3.35E-05	2.50E-05	2.15E-01
BRAZING	GR3 Silver	1.65E-05	8.25E-07	3.35E-05	9.27E-04	2.15E-01
GTAW	E308	9.09E-03	4.54E-04	3.85E-03	2.30E-03	2.15E-01
GTAW	E309	9.09E-03	4.54E-04	3.85E-03	2.30E-03	2.15E-01
GTAW	E316	9.09E-03	4.54E-04	3.85E-03	2.30E-03	2.15E-01
GTAW	E347	9.09E-03	4.54E-04	3.85E-03	2.30E-03	2.15E-01
GTAW	ECuNi Monel 67	1.65E-05	8.25E-07	2.09E-03	3.42E-03	2.15E-01
GTAW	RN 67	1.65E-05	8.25E-07	5.25E-03	4.72E-03	2.15E-01
GTAW	RN 60	1.65E-05	8.25E-07	5.25E-03	4.72E-03	2.15E-01
GTAW	RN 82	1.65E-05	8.25E-07	5.25E-03	4.72E-03	2.15E-01
GTAW	ERCu - 2	1.65E-05	8.25E-07	3.35E-05	2.50E-05	2.15E-01
GTAW	190093	3.30E-05	1.65E-06	1.79E-03	3.36E-03	2.15E-01
GTAW	Monel 67	3.30E-05	1.65E-06	1.79E-03	3.36E-03	2.15E-01
GTAW	R5356	6.60E-05	3.30E-06	5.91E-04	2.50E-05	2.15E-01
GTAW	ER70S	1.65E-04	8.25E-06	2.63E-03	1.62E-04	2.15E-01

**Attachment 3. (cont.)**

**Basis for the Proposed Welding Emission Factors for**

- 1. Stainless Steels**
- 2. Mild Steels**
- 3. Alloy Steels**

### Attachment 3. Summary of Welding Emission Factors<sup>1</sup> (Cont.)

**Summary of Welding Information - by welding process and type of electrode--**  
compiled on 11-22-04. (Last Revised 2/26/05). Summary includes data from 12 shipyards  
(Newport News Shipyard data is CBI) for baseline year - 1999. Welding Rod/Wire  
Consumption = Annual Usage – Waste

Welding Process	Type of electrode	Comment (Basis for proposed emission factors)
SMAW	E308	Use new SMAW/SS factors
SMAW	E309	Use new SMAW/SS factors
SMAW	E310	Use new SMAW/SS factors
SMAW	E316	Use new SMAW/SS factors
SMAW	E347	Use new SMAW/SS factors
SMAW	E429	Use new SMAW/SS factors
SMAW	E6010	Use SMAW/7018/7028 factors.
SMAW	E6011	Use SMAW/7018/7028 factors.
SMAW	E6013	Use SMAW/7018/7028 factors.
SMAW	E7018	Use SMAW/7018/7028 factors.
SMAW	E7024	Use SMAW/7018/7028 factors.
SMAW	E70/30	Use SMAW/7018/7028 factors.
SMAW	E8018	Use SMAW/7018/7028 factors.
SMAW	E9018	Use SMAW/7018/7028 factors.
SMAW	E10018	Use SMAW/7018/7028 factors.
SMAW	E11018	Use SMAW/7018/7028 factors.
SMAW	E9N10	Use AP-42 for TSP, composition curves
SMAW	E1N12	Use AP-42 for TSP, composition curves
SMAW	E8N12	Use AP-42 for TSP, composition curves
SMAW	ENiCl	Use AP-42 for TSP, composition curves
SMAW	Nickel 61	Use AP-42 for TSP, composition curves
SMAW	Ni-Rod 99X	Use AP-42 for TSP, composition curves
SMAW	ED029203	Use SMAW/7018/7028 factors.
SMAW	RN60	Use AP-42 for TSP, composition curves
SMAW	KOBESUS-43	Use SMAW/7018/7028 factors.
SMAW	MIL 67	Use AP-42 for TSP, composition curves
SMAW	Arc Rod	Use AP-42 for TSP, composition curves
SMAW	187N	Use AP-42 for TSP, composition curves
SMAW	BCUP 5	Use AP-42 for TSP, composition curves
SMAW	E2209	Use AP-42 for TSP, composition curves
SMAW	E4043	Use AP-42 for TSP, composition curves
SMAW	E5556	Use SMAW/7018/7028 factors.
SMAW	E70S	Use SMAW/7018/7028 factors.
SMAW	E80S	Use SMAW/7018/7028 factors.
SMAW	ECuSn	Use AP-42 for TSP, composition curves

<sup>1</sup> Stainless Steels, Mild Steels, and Alloy Steels

Welding Process	Type of electrode	Comment (Basis for proposed emission factors)
SMAW	E12018	Use SMAW/7018/7028 factors.
SMAW	E7028	Use SMAW/7018/7028 factors.
SMAW	LIN-L70	Use SMAW/7018/7028 factors.
SMAW	EIA2A	Use AP-42 for TSP, composition curves
GMAW	E308	Use new GMAW/SS factors
GMAW	E309	Use new GMAW/SS factors
GMAW	E310	Use new GMAW/SS factors
GMAW	E316	Use new GMAW/SS factors
GMAW	E347	Use new GMAW/SS factors
GMAW	(LC 33) HD/Face (FC)	Use GMAW E70S (-3 to -6) data
GMAW	Arc Rod	Use AP-42 for TSP, composition curves
GMAW	BCUP 5	Use GMAW E70S (-3 to -6) data
GMAW	ECuSn	Use GMAW E70S (-3 to -6) data
GMAW	DS7100	Use GMAW E70S (-3 to -6) data
GMAW	E100	Use GMAW E70S (-3 to -6) data
GMAW	E10018	Use GMAW E70S (-3 to -6) data
GMAW	E110	Use GMAW E70S (-3 to -6) data
GMAW	E11018	Use GMAW E70S (-3 to -6) data
GMAW	E2209	Use AP-42 for TSP, composition curves
GMAW	E4043	Use AP-42 for TSP, composition curves
GMAW	E5356	Use GMAW E70S (-3 to -6) data
GMAW	E5556	Use GMAW E70S (-3 to -6) data
GMAW	E70S	Use GMAW E70S (-3 to -6) data
GMAW	E7018	Use GMAW E70S (-3 to -6) data
GMAW	E80S	Use GMAW E70S (-3 to -6) data
GMAW	E8018	Use GMAW E70S (-3 to -6) data
GMAW	E8N12	Use AP-42 for TSP, composition curves
GMAW	E9018	Use GMAW E70S (-3 to -6) data
GMAW	E9N10	Use AP-42 for TSP, composition curves
GMAW	EB1	Use GMAW E70S (-3 to -6) data
GMAW	ECu	Use AP-42 for TSP, composition curves
GMAW	ECuAl	Use AP-42 for TSP, composition curves
GMAW	ECuNi	Use AP-42 for TSP, composition curves
GMAW	ECuNiAl	Use AP-42 for TSP, composition curves
GMAW	ECuSi	Use AP-42 for TSP, composition curves
GMAW	ECuSn	Use AP-42 for TSP, composition curves
GMAW	ECuZn	Use AP-42 for TSP, composition curves
GMAW	EN60	Use AP-42 for TSP, composition curves
GMAW	EN625IN	Use AP-42 for TSP, composition curves
GMAW	EN67	Use AP-42 for TSP, composition curves
GMAW	ENi	Use AP-42 for TSP, composition curves
GMAW	ENiCrFe	Use AP-42 for TSP, composition curves
GMAW	ENiCu	Use AP-42 for TSP, composition curves
GMAW	METALLIZING	Use AP-42 for TSP, composition curves

Welding Process	Type of electrode	Comment (Basis for proposed emission factors)
GMAW	MIL 67	Use AP-42 for TSP, composition curves
GMAW	Ni-Rod 55	Use AP-42 for TSP, composition curves
GMAW	RN60	Use AP-42 for TSP, composition curves
GMAW	RN625	Use AP-42 for TSP, composition curves
GMAW	RN67	Use AP-42 for TSP, composition curves
GMAW	RN82	Use AP-42 for TSP, composition curves
GMAW	WELDING	Use GMAW E70S (-3 to -6) data
FCAW	E308	Use new FCAW/SS factors
FCAW	E309	Use new FCAW/SS factors
FCAW	E316	Use new FCAW/SS factors
FCAW	E347	Use new FCAW/SS factors
FCAW	MIL101TC	Use AP-42 for TSP, composition curves
FCAW	E101	Use FCAW E70T/E71T data
FCAW	E120S	Use AP-42 for TSP, composition curves
FCAW	E70S/T	Use FCAW E70T/E71T data
FCAW	E71T	Use FCAW E70T/E71T data
FCAW	TM771	Use FCAW/E71M (771) data
FCAW	E80S/T	Use FCAW/E71M (771) data
FCAW	E81T	Use FCAW/E71M (771) data
FCAW	E8AT	Use FCAW/E71M (771) data
FCAW	EM12K	Use FCAW/E71M (771) data
SAW	EL12 (L-60)	Use AP-42: (FGR) x (% Metal in Fume)
SAW	EM12K	Use AP-42: (FGR) x (% Metal in Fume)
SAW	ENi	Use AP-42: (FGR) x (% Metal in Fume)
SAW	Flux F72	Use AP-42: (FGR) x (% Metal in Fume)
SAW	SP/Arc 86	Use AP-42: (FGR) x (% Metal in Fume)
SAW	WM1093	Use AP-42: (FGR) x (% Metal in Fume)
SAW	KOBESUS-43	Use AP-42: (FGR) x (% Metal in Fume)
SAW	LIN-L70 (AWS EA1)	Use AP-42: (FGR) x (% Metal in Fume)
SAW	WM1095	Use AP-42: (FGR) x (% Metal in Fume)
MISC	Carbons	Use AP-42: (FGR) x (% Metal in Fume)
BRAZING	GR3 Silver	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	E308	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	E309	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	E316	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	E347	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	ECuNi Monel 67	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	RN 67	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	RN 60	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	RN 82	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	ERCu - 2	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	190093	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	Monel 67	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	R5356	Use AP-42: (FGR) x (% Metal in Fume)
GTAW	ER70S	Use AP-42: (FGR) x (% Metal in Fume)

## **DATA SET OCTOBER 01, 2004**

### **ATTACHMENTS:**

- 4. Summary of SMAW with Stainless Steel Electrodes – Data set**
- 5. Summary of GMAW with Stainless Steel Electrodes – Data set**
- 6. Summary of FCAW with Stainless Steel Electrodes – Data set**
- 7. Summary of SMAW with NON-Stainless (e.g., Mild) Steel Electrodes – Data set**
- 8. Summary of GMAW with NON-Stainless (e.g., Mild) Steel Electrodes – Data set**
- 9. Summary of FCAW with NON-Stainless (e.g., Mild) Steel Electrodes – Data set**

**Attachment 4. Summary of SMAW with Stainless Steel Electrodes -- Data set: October 01, 2004**

Welding Process	Source of Data	Type Rod	Test No. or Ref.	Run No.	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
SMAW	NSRP 0574	E308-16	1	1 of 3	7.07E-01	1.50E-01	3.54E-01	5.72E-02	3.20E-02	1999 data
SMAW	NSRP 0574	and	1	2 of 3	4.89E-01	1.36E-01	3.67E-01	3.49E-02	7.33E-03	
SMAW	NSRP 0574	E308L-16	1	3 of 3	5.95E-01	1.51E-01	2.98E-01	4.34E-02	9.55E-03	
SMAW	NSRP 0574	E308-17	6	1 of 3	3.68E-01	7.49E-02	3.45E-01	3.10E-02	9.07E-03	
SMAW	NSRP 0574	E308-17	6	2 of 3	6.71E-01	1.20E-01	5.87E-01	6.92E-02	1.57E-02	
SMAW	NSRP 0574	E308L-17	6	3 of 3	6.55E-01	1.27E-01	5.75E-01	5.40E-02	1.15E-02	
SMAW	NSRP 0574	E308-17	8	1 of 3	1.14E+00	2.20E-01	8.16E-01	2.10E-01	4.78E-03	
SMAW	NSRP 0574	E308-17	8	2 of 3	1.19E+00	1.72E-01	8.60E-01	2.27E-01	4.78E-03	
SMAW	NSRP 0574	E308H-17	8	3 of 3	1.20E+00	1.63E-01	8.61E-01	2.28E-01	4.81E-03	
SMAW	NSRP 0574	E316-16	4	1 of 3	9.32E-01	2.19E-01	4.52E-01	8.33E-02	9.18E-03	
SMAW	NSRP 0574	E316-16	4	2 of 3	1.01E+00	2.28E-01	5.06E-01	9.63E-02	6.38E-03	
SMAW	NSRP 0574	E316L-16	4	3 of 3	5.44E-01	1.24E-01	2.98E-01	5.33E-02	5.44E-03	
SMAW	CARB1	E316L-16	CARB-1	1 of 4	ND	2.15E-01	ND	ND	ND	2004 data:
SMAW	CARB1	E316L-16	CARB-1	1 of 4	ND	1.81E-01	ND	ND	ND	CARB only tested
SMAW	CARB1	E316L-16	CARB-1	1 of 4	ND	1.57E-01	ND	ND	ND	for Cr+6.
SMAW	CARB1	E316L-16	CARB-1	1 of 4	ND	1.70E-01	ND	ND	ND	
SMAW	NSRP 0574	E309-16	2	1 of 3	8.19E-01	3.06E-03	4.03E-01	6.04E-02	7.91E-03	
SMAW	NSRP 0574	E309-16	2	2 of 3	6.57E-01	1.63E-01	3.08E-01	5.59E-02	6.99E-03	
SMAW	NSRP 0574	E309-16	2	3 of 3	7.49E-01	9.35E-02	3.66E-01	6.53E-02	7.01E-03	
SMAW	NSRP 0574	E309-17	3	1 of 3	5.31E-01	1.52E-01	3.23E-01	4.16E-02	5.62E-03	
SMAW	NSRP 0574	E309-17	3	2 of 3	6.61E-01	9.19E-02	4.00E-01	5.31E-02	5.87E-03	
SMAW	NSRP 0574	E309L-17	3	3 of 3	8.60E-01	3.20E-03	5.90E-01	6.50E-02	8.90E-03	
SMAW	ESAB	309L-16	ESAB-1	1 run	2.03E-01	1.38E-01	2.67E-01	1.63E+02	ND	2000 data
SMAW	AP-42	E308L-15	Ref. 15*	1 run	3.84E-01	1.92E-01	2.71E-01	2.50E-02	ND	
SMAW	AP-42	E316-15	Ref. 15*	1 run	4.84E-01	3.53E-01	4.21E-01	3.70E-02	4.70E-03	

\* - Refers to test numbers identified in AP-42, CARB, or ESAB referenced documents.

**NOTES:**

1. Data for total Cr, Cr+6, Mn, and Ni were used for determining EFs at 95% UCL (upper confidence level) of the mean in Attachment 1.
2. Hexavalent chromium (Cr+6) data point 3.53-01 (g/kg) was determined to be an outlier using non-parametric box plot, hence the data point was not used for determining the EF at 95 % UCL of the mean in Attachment 1.

3. A default value for lead equal to 0.215 g/kg ( maximum value for mild steel data) was used instead of the above data.
4. ND stands for not determined.



**Attention 5. Summary of GMAW with Stainless Steel Electrodes -- Data set: October 01, 2004**

Welding Process	Source of Data	Type Rod	Test No. or Ref.*	Run No.	Total Cr		Manganese	Nickel	Lead	Note/Comments
					(g/kg)	Cr+6 (g/kg)	[Mn] (g/kg)	[Ni] (g/kg)	[Pb] (g/kg)	
GMAW	NSRP 0587	309	8	1 of 3	4.76E+00	6.65E-02	1.79E+01	5.03E+02	0.00E+00	2000 data
GMAW	NSRP 0587	309	8	2 of 3	6.40E+00	6.32E-02	1.37E+01	7.05E+02	0.00E+00	
GMAW	NSRP 0587	309	8	3 of 3	6.51E+00	5.36E-02	1.23E+01	ND	6.13E-02	
GMAW	ESAB	ER309L	ESAB-2	1 run	7.29E-01	6.82E-03	6.21E-01	2.11E-01	ND	2000 data
GMAW	NSRP 0587	316	14	1 of 3	8.98E-01	4.57E-02	2.73E+00	7.16E+01	0.00E+00	2000 data
GMAW	NSRP 0587	316	14	2 of 3	1.30E+00	1.69E-02	3.52E+00	9.44E+01	0.00E+00	
GMAW	NSRP 0587	316	14	3 of 3	8.99E-01	7.40E-03	2.71E+00	6.59E+01	0.00E+00	
GMAW	CARB	308L	CARB-2	1 of 3	ND	4.97E-02	ND	ND	ND	2004 data
GMAW	CARB	308L	CARB-2	2 of 3	ND	1.61E-02	ND	ND	ND	
GMAW	CARB	308L	CARB-2	3 of 3	ND	1.64E-02	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-3	1 of 3	ND	4.60E-03	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-3	2 of 3	ND	8.93E-03	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-3	3 of 3	ND	1.24E-02	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-4	1 of 4	ND	3.35E-02	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-4	2 of 4	ND	2.49E-02	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-4	3 of 4	ND	2.11E-02	ND	ND	ND	
GMAW	CARB	E316L-Si	CARB-4	4 of 4	ND	2.23E-02	ND	ND	ND	

\* - Refers to test numbers identified in AP-42, ESAB, or CARB referenced documents.

**NOTES:**

1. Data for total Cr were used for determining EFs at 95% UCL of the mean in Attachment 1.
2. Default values were used for determining UCLs in Attachment 1 for Mn, Ni, and Pb.
3. A default value for lead equal to 0.215 g/kg ( maximum value for mild steel data) was used.
5. ND stands for not determined.

**Attachment 6. Summary of FCAW with Stainless Steel Electrodes -- Data set: October 01, 2004**

Welding Process	Source of Data	Type Rod	Test No.*	Run No.	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
FCAW	NSRP 0587	316	12	1 of 3	1.86E+00	7.07E-02	2.22E+01	1.60E+02	0.00E+00	2000 data
FCAW	NSRP 0587	316	12	2 of 3	3.04E+00	3.35E-02	2.85E+01	2.21E+02	0.00E+00	
FCAW	NSRP 0587	316	12	3 of 3	ND	6.34E-02	0.00E+00	ND	0.00E+00	
FCAW	NSRP 0587	309	11	1 of 3	2.42E+00	1.12E-01	6.35E+00	8.85E+01	6.38E-02	
FCAW	NSRP 0587	309	11	2 of 3	2.82E+00	6.67E-02	6.90E+00	1.12E+02	0.00E+00	
FCAW	NSRP 0587	309	11	3 of 3	2.86E+00	2.65E-02	7.72E+00	1.10E+02	6.40E-02	
FCAW	ESAB	309L Xtra	ESAB-3	1 run	7.78E-01	2.02E-02	7.58E-01	1.37E-01	ND	2000 data
FCAW	CARB	309LT-1	CARB-5	1 of 6	ND	1.54E-02	ND	ND	ND	
FCAW	CARB	309LT-1	CARB-5	2 of 6	ND	1.51E-02	ND	ND	ND	
FCAW	CARB	309LT-1	CARB-5	3 of 6	ND	1.39E-02	ND	ND	ND	
FCAW	CARB	309LT-1	CARB-5	4 of 6	ND	1.49E-02	ND	ND	ND	2004 data;
FCAW	CARB	309LT-1	CARB-5	5 of 6	ND	1.43E-02	ND	ND	ND	CARB only tested
FCAW	CARB	309LT-1	CARB-5	6 of 6	ND	1.32E-02	ND	ND	ND	for Cr+6.

\* - Refers to test numbers identified in NSRP, ESAB, or CARB referenced documents.

**NOTES:**

1. Data for total Cr and Cr+6 were used for determining EFs at 95% UCL of the mean in Attachment 1.
2. Default values were used for determining UCLs in Attachment 1 for Mn, Ni, and Pb.
3. A default value for lead equal to 0.215 g/kg ( maximum value for mild steel data) was used.
4. Data point 1.12E-01 (g/kg) for Cr+6 is an outlier (based on nonparametric box-plot), hence it was not used to determine the EF in Attachment 1.
5. ND stands for not determined.

**Attachment 7. Summary of SMAW with NON-Stainless (e.g., Mild) Steel Electrodes and 14Mn-4Cr (alloy steel) -- Data set:10/ 01/04**

Welding Process	Source of Data	Type Rod	Test No.*	No. Runs	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Notes/Comments
SMAW	AP-42	E7018	Ref. 15*	1 run	1.00E-02	ND	9.62E-01	ND	AP-42 Ref. 15 (1986 report)
SMAW	AP-42	E7028	Ref. 15*	1 of 3	1.17E-02	ND	9.85E-01	ND	AP-42 Ref. 15 (1986 report)
SMAW	AP-42	E7028	Ref. 15*	2 of 3	ND	ND	7.38E-01	ND	AP-42 Ref. 15 (1986 report)
SMAW	AP-42	E7028	Ref. 15*	3 of 3	ND	ND	7.38E-01	ND	AP-42 Ref. 15 (1986 report)
SMAW	AP-42	E7018	Ref. 11	6 runs	ND	ND	1.33E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E7018	Ref. 11	5 runs	ND	ND	1.72E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E7018	Ref. 11	6 runs	ND	ND	8.46E-01	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E7018	Ref. 11	6 runs	ND	ND	8.91E-01	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E7018	Ref. 11	6 runs	ND	ND	7.65E-01	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E11018-M	Ref. 11	6 runs	ND	ND	2.12E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E11018-M	Ref. 11	6 runs	ND	ND	1.27E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E11018-M	Ref. 11	6 runs	ND	ND	1.03E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E11018-M	Ref. 11	6 runs	ND	ND	1.16E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	E11018-M	Ref. 11	6 runs	ND	ND	1.12E+00	ND	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	14Mn-4Cr	Ref. 11	4 runs	1.54E+00	ND	1.97E+01	2.50E+00	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	14Mn-4Cr	Ref. 11	3 runs	1.47E+00	ND	3.30E+01	2.75E-01	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	14Mn-4Cr	Ref. 11	5 runs	1.02E+00	ND	2.08E+01	2.27E+00	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	14Mn-4Cr	Ref. 11	5 runs	1.50E+00	ND	2.25E+01	2.38E+00	AP-42 Ref. 11 (1987 report)
SMAW	AP-42	14Mn-4Cr	Ref. 11	6 runs	1.50E+00	ND	2.10E+01	9.27E-01	AP-42 Ref. 11 (1987 report)

\* - Refers to test numbers identified in AP-42 referenced documents.

**NOTES:**

**A. Mild Steels**

1. Data for Mn were used for determining EFs at 95% UCL of the mean in Attachment 2;  
The first four data EF values for E7018 and E7028 electrodes are for single runs. We combined the single runs with the rest of the data for E7018 and E11018-M, where EF values are the average of six runs (except in one case).

2. Data point 2.12E+00 (g/kg) for E11018-M was determined (box-plot) to be an outlier; it was not used to determine the EF in Attachment 2.
3. Default values were used for determining UCLs in Attachment 2 for Cr, Cr+6, and Pb.
4. A default value for lead equal to 0.215 g/kg ( maximum value for mild steel data) was used.

**B. Alloy Steel (14Mn-4Cr)**

5. Data for Cr, Mn, and Ni were used for determining the EFs in Attachment 3. Basis for the EFs for the other alloy steels is explained in Attachment 3 (cont.).
6. The single runs used for determining these average EFs were not provided.
7. ND stands for not determined.

**Attachment 8. Summary data of GMAW with NON-Stainless (e.g., Mild) Steel Electrodes -- Data set: October 01, 2004**

Welding Process	Source of Data	Type Rod	Test No.*	No. Runs	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
GMAW	AP-42	E70S-3	Ref. 46	1 of 15	ND	ND	2.82E-01	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70S-3	Ref. 46	2 of 15	ND	ND	1.92E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	3 of 15	ND	ND	2.66E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	4 of 15	ND	ND	4.49E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	5 of 15	ND	ND	2.02E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	6 of 15	ND	ND	2.02E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	7 of 15	ND	ND	1.86E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	8 of 15	ND	ND	3.09E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	9 of 15	ND	ND	4.79E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	10 of 15	ND	ND	2.18E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	11 of 15	ND	ND	4.53E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	12 of 15	ND	ND	1.81E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	13 of 15	ND	ND	2.56E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	14 of 15	ND	ND	3.39E-01	ND	ND	
	AP-42	E70S-3	Ref. 46	15 of 15	ND	ND	1.76E-01	ND	ND	
GMAW	AP-42	E70S-3	Ref. 51	1 run	1.72E-03	ND	5.76E-01	6.19E-04	ND	AP-42 Ref. 51 (1991 report)
GMAW	AP-42	E70S-5	Ref. 46	1 run	ND	ND	2.30E-01	ND	ND	AP-42 Ref. 46 (1979 report)
GMAW	AP-42	E70S-6	Ref. 15	1 run	3.78E-03	ND	3.94E-01	ND	ND	AP-42 Ref. 15 (1986 report)
GMAW	AP-42	E70S-6	Ref. 51	1 run	1.19E-03	ND	8.22E-01	1.11E-03	ND	AP-42 Ref. 51 (1991 report)
GMAW	NSRP 0587	E70S-6	5	1 of 3	NA	N/A	8.02E+00	2.56E+00	1.41E-01	Yr 2000 report; data were not used; memo for docket.
	NSRP 0587	E70S-6	5	2 of 3	6.83E-02	0.00E+00	1.28E+01	2.50E+00	2.15E-01	
	NSRP 0587	E70S-6	5	3 of 3	8.01E-02	4.05E-03	N/A	N/A	N/A	
GMAW	AP-42	ER1260	Ref. 15	1 run	4.10E-03	ND	ND	ND	ND	AP-42 Ref. 15 (1986 report)
GMAW	AP-42	ER5154	Ref. 15	1 run	9.64E-03	ND	3.37E-02	ND	ND	AP-42 Ref. 15 (1986 report)

\* - Refers to test numbers identified in AP-42 or NSRP referenced documents.

**NOTES:**

1. Data for total Cr and Mn were used for determining EFs at 95% UCL (upper confidence level) of the mean in Attachment 2.
2. Default values were used for determining UCLs in Attachment 2 for Cr+6, Ni, and Pb.
3. A default value for lead equal to 0.215 g/kg ( maximum value for mild steel data) was used.
4. ND stands for not determined.

**Attachment 9. Summary of FCAW with NON-Stainless (e.g., Mild) Steel Electrodes -- Data set: October 01, 2004**

Welding Process	Source of Data	Type Rod	Ref. or Test No.*	No. Runs	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
FCAW	AP-42	E70T-1	Ref. 12	1 of 5	2.40E-03	ND	1.30E+00	3.60E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-1	Ref. 12	2 of 5	1.46E-03	ND	6.94E-01	2.19E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-1	Ref. 12	3 of 5	1.54E-03	ND	1.11E+00	6.16E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-1	Ref. 12	4 of 5	3.76E-03	ND	1.27E+00	7.52E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-1	Ref. 12	5 of 5	3.60E-03	ND	1.22E+00	7.20E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-1	Ref. 46	1 of 6	ND	ND	8.58E-01	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 46	2 of 6	ND	ND	1.63E+00	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 46	3 of 6	ND	ND	1.17E+00	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 46	4 of 6	ND	ND	1.50E+00	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 46	5 of 6	ND	ND	7.49E-01	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 46	6 of 6	ND	ND	7.73E-01	ND	ND	AP-42 Ref. 46 (1979 report)
	AP-42	E70T-1	Ref. 48	1 of 4	ND	ND	5.50E-01	ND	ND	
	AP-42	E70T-1	Ref. 48	2 of 4	ND	ND	6.00E-01	ND	ND	
	AP-42	E70T-1	Ref. 48	3 of 4	ND	ND	5.50E-01	ND	ND	
	AP-42	E70T-1	Ref. 48	4 of 4	ND	ND	6.00E-01	ND	ND	
	AP-42	E70T-1	Ref. 51	1 run	1.13E-03	ND	7.83E-01	5.05E-04	ND	AP-42 Ref. 51 (1991 report)
	AP-42	E70T-2	Ref. 12	1 of 2	1.19E-03	ND	1.25E+00	2.38E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-2	Ref. 12	2 of 2	9.80E-04	ND	1.03E+00	1.96E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	1 of 6	1.70E-03	ND	1.19E-01	8.50E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	2 of 6	1.46E-03	ND	2.04E-01	2.92E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	3 of 6	2.18E-03	ND	2.18E-01	1.31E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	4 of 6	1.90E-03	ND	3.42E-01	5.70E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	5 of 6	2.30E-03	ND	3.68E-01	4.60E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 12	6 of 6	2.60E-03	ND	4.94E-01	5.20E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 46	1 of 3	ND	ND	4.39E-01	1.33E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-4	Ref. 46	2 of 3	ND	ND	6.12E-01	1.33E-03	ND	

Welding Process	Source of Data	Type Rod	Ref. or Test No.*	No. Runs	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
	AP-42	E70T-4	Ref. 46	3 of 3	ND	ND	1.33E-01	1.33E-03	ND	
	AP-42	E70T-4	Ref. 48	1 of 4	ND	ND	3.60E-01	ND	ND	
	AP-42	E70T-4	Ref. 48	2 of 4	ND	ND	4.00E-01	ND	ND	
	AP-42	E70T-4	Ref. 48	3 of 4	ND	ND	4.00E-01	ND	ND	
	AP-42	E70T-4	Ref. 48	4 of 4	ND	ND	4.00E-01	ND	ND	
	AP-42	E70T-5	Ref. 12	1 of 8	8.80E-04	ND	6.78E-01	3.52E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	2 of 8	1.13E-03	ND	8.81E-01	3.39E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	3 of 8	2.94E-03	ND	1.13E+00	2.94E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	4 of 8	1.22E-03	ND	1.02E+00	3.66E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	5 of 8	3.76E-03	ND	2.26E+00	1.88E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	6 of 8	3.46E-03	ND	1.52E+00	3.46E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	7 of 8	5.52E-03	ND	1.47E+00	5.52E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 12	8 of 8	4.46E-03	ND	2.68E+00	2.23E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 46	1 run	ND	ND	2.26E+00	ND	ND	
	AP-42	E70T-5	Ref. 48	1 of 4	ND	ND	7.20E-01	ND	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 48	2 of 4	ND	ND	8.00E-01	ND	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 48	3 of 4	ND	ND	8.40E-01	ND	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-5	Ref. 48	4 of 4	ND	ND	8.80E-01	ND	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-7	Ref. 12	1 of 3	3.45E-02	ND	1.70E-01	9.20E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-7	Ref. 12	2 of 3	2.90E-03	ND	2.15E-01	1.16E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-7	Ref. 12	3 of 3	4.10E-03	ND	3.12E-01	1.23E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-G	Ref. 12	1 of 5	7.50E-04	ND	1.07E+00	2.18E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-G	Ref. 12	2 of 5	2.49E-03	ND	1.16E+00	5.40E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-G	Ref. 12	3 of 5	7.05E-04	ND	9.38E-01	2.12E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-G	Ref. 12	4 of 5	2.52E-03	ND	1.18E+00	5.46E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E70T-G	Ref. 12	5 of 5	2.94E-03	ND	1.53E+00	4.02E-02	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	1 of 7	2.70E-03	ND	1.22E+00	3.60E-03	ND	AP-42 Ref. 12 (1986 report)



Welding Process	Source of Data	Type Rod	Ref. or Test No.*	No. Runs	Total Cr (g/kg)	Cr+6 (g/kg)	Manganese [Mn] (g/kg)	Nickel [Ni] (g/kg)	Lead [Pb] (g/kg)	Notes/Comments
	AP-42	E71T-1	Ref. 12	2 of 7	ND	ND	ND	ND	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	3 of 7	7.30E-04	ND	7.30E-01	2.19E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	4 of 7	1.52E-03	ND	1.09E+00	3.80E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	5 of 7	1.94E-03	ND	1.39E+00	4.85E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	6 of 7	4.02E-03	ND	1.05E+00	5.36E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 12	7 of 7	2.02E-03	ND	1.06E+00	6.06E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-1	Ref. 51	1 run	1.68E-03	ND	9.72E-01	4.80E-04	ND	AP-42 Ref. 51 (1991 report)
	AP-42	E71T-11	Ref. 12	1 of 3	1.90E-03	ND	2.28E-01	5.70E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-11	Ref. 12	2 of 3	2.10E-03	ND	2.52E-01	6.30E-03	ND	AP-42 Ref. 12 (1986 report)
	AP-42	E71T-11	Ref. 12	3 of 3	1.70E-03	ND	2.04E-01	5.10E-03	ND	AP-42 Ref. 12 (1986 report)
<b>FCAW</b>	NSRP 0587	E71-M	6	1 of 3	1.96E-02	8.69E-04	1.34E+01	1.99E+00	5.21E-02	
	NSRP 0587	E71-M	6	2 of 3	5.09E-02	5.08E-02	2.18E+01	0.00E+00	4.58E-02	
	NSRP 0587	E71-M	6	3 of 3	4.10E-01	2.83E-02	N/A	0.00E+00	0.00E+00	
	AP-42	E110T5-K3	Ref. 12	1 run	2.08E-03	ND	2.02E+00	1.12E-01	ND	AP-42 Ref. 12 (1986 report)
<b>FCAW</b>	AP-42	14Mn-4Cr	Ref. 11	6 runs	1.05E+00	ND	1.38E+01	1.24E+00	ND	AP-42 Ref. 11 (1987 report)
	AP-42	14Mn-4Cr	Ref. 11	5 runs	8.84E-01	ND	1.38E+01	2.08E-01	ND	AP-42 Ref. 11 (1987 report) (15% Mn, 4% Cr)
<b>FCAW</b>	NSRP 0587	E770 (E71T)	7	1 of 3	2.42E-02	2.65E-03	2.07E+01	8.62E+00	6.73E-02	Data was not used:
	NSRP 0587	E770	7	2 of 3	5.09E-02	0.00E+00	3.26E+01	1.20E+01	9.88E-02	see memo to docket.
	NSRP 0587	E770	7	3 of 3	6.24E-02	2.46E-03	2.36E+01	1.11E+01	9.36E-02	

\* - Refers to test numbers identified in AP-42 or NSRP referenced documents.

**NOTES:**

1. Data for total Cr, Mn, and Ni were used for determining EFs at 95% UCL of the mean in Attachment 2.
2. Default values were used for determining UCLs in Attachment 2 for Cr+6, Ni, and Pb.
3. A default value for lead equal to 0.215 mg/kg ( maximum value for mild steel data) was used.
4. Could not find electrode E770 under the AWS classification. It is likely to have been TRI-MARK TM770 (Several electrodes exist: AWS classification E71T-1M up to 12MJ).

<b>Welding Process</b>	<b>Source of Data</b>	<b>Type Rod</b>	<b>Ref. or Test No.*</b>	<b>No. Runs</b>	<b>Total Cr (g/kg)</b>	<b>Cr+6 (g/kg)</b>	<b>Mangane se [Mn] (g/kg)</b>	<b>Nickel [Ni] (g/kg)</b>	<b>Lead [Pb] (g/kg)</b>	<b>Notes/Comments</b>
----------------------------	---------------------------	-----------------	------------------------------	-----------------	----------------------------	------------------------	---------------------------------------	-----------------------------------	---------------------------------	-----------------------

5. NSRP 0587 data for E770 were not used. The reasons are explained in a separate memo.

6. ND stands for not determined.