

**Appendix B: Tables B1 to B43
(Tabular Data on Fume Generation Characteristics
of Electrodes Used in Part II)**

Table B1
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E6010 (IP) covered electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
				Measured g/min	Normalized g/min/l ^{1/2} x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E6010 IP	1	31	145	1.08	4.82	3.74	1.74	3.83	---	---	---	4.14	0.11
E6010 IP	1	32	150	1.07	4.77	3.65	1.77	3.89	---	---	---	4.10	0.10
E6010 IP	1	31	150	1.09	5.13	3.70	1.77	3.90	---	---	---	4.14	0.11
E6010 IP	1	30	150	1.08	4.82	3.51	1.85	4.08	1.38	3.04	47.05	3.88	0.10
				Avg 1.08 SD >0.01	Avg 4.89 SD 0.17	Avg 3.65 SD 0.10	Avg 1.78 SD 0.05	Avg 3.93 SD 0.11	---	---	Avg 4.07 SD 0.12	Avg 4.07 SD 0.12	0.11
E6010 IP	2	28	150	0.59	2.62	2.13	1.66	3.65	---	---	---	2.76	0.07
E6010 IP	2	29	148	0.58	2.63	2.19	1.58	3.45	---	---	---	2.36	0.06
E6010 IP	2	29	150	0.57	2.47	2.13	1.61	3.55	---	---	---	2.36	0.06
E6010 IP	2	28	150	0.58	2.59	2.23	1.86	4.09	1.47	3.24	23.77	2.06	0.05
				Avg 0.58 SD >0.01	Avg 2.58 SD 0.07	Avg 2.19 SD 0.04	Avg 1.68 SD 0.13	Avg 3.69 SD 0.28	---	---	Avg 2.39 SD 0.29	Avg 2.39 SD 0.29	0.06
E6010 IP	11	27	160	1.19	4.97	3.65	1.96	4.32	---	---	---	4.17	0.11
E6010 IP	11	28	155	1.20	4.70	3.68	1.96	4.32	---	---	---	4.17	0.11
E6010 IP	11	28	155	1.20	4.68	3.67	1.96	4.32	---	---	---	4.17	0.11
E6010 IP	11	28	160	1.20	4.99	5.79	1.90	4.18	1.32	2.91	54.36	4.17	0.11
				Avg 1.20 SD >0.01	Avg 4.84 SD 0.17	Avg 3.70 SD 0.06	Avg 1.95 SD 0.03	Avg 4.29 SD 0.07	---	---	Avg 4.17 SD 0.00	Avg 4.17 SD 0.00	0.11
E6010	1	27	145	0.45	2.15	1.60	1.70	3.73	1.29	2.84	20.08	1.72	0.04
E6010	1	27	145	0.46	2.20	1.64	1.70	3.73	1.30	2.85	21.44	1.77	0.04
E6010	1	26	145	0.43	2.06	1.46	1.78	3.92	1.50	3.30	17.32	1.63	0.04
E6010	1	26	145	0.44	2.09	1.54	1.72	3.79	1.51	3.34	17.39	1.66	0.04
E6010	1	26	145	0.44	2.09	1.48	1.79	3.94	1.51	3.32	17.49	1.63	0.04
				Avg 0.45 SD 0.01	Avg 2.12 SD 0.06	Avg 1.54 SD 0.08	Avg 1.74 SD 0.05	Avg 3.82 SD 0.10	1.42	3.13	Avg 18.92 SD 2.09	Avg 1.68 SD 0.06	0.04
E6010 IP	11	23.5	150	0.83	3.69	2.74	1.83	4.00	1.43	3.15	34.78	3.17	0.08
E6010 IP	11	23.0	150	0.83	3.69	2.70	1.84	4.06	1.42	3.13	35.00	3.13	0.08
E6010 IP	11	23.0	150	0.83	3.69	2.68	1.86	4.10	1.43	3.15	34.78	3.09	0.08
				Avg 0.83 SD >0.01	Avg 3.69 SD >0.01	Avg 2.71 SD 0.03	Avg 1.84 SD 0.02	Avg 4.06 SD 0.02	1.43	3.14	Avg 35.85 SD 0.13	Avg 3.13 SD 0.04	0.08

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 1, 2, and 11 electrodes: 4.02 mm/s (9.5 in./min)

Electrode weight:

Code 1 electrode: 111.02 g/m (2.82 g/in.)

Code 2 electrode: 108.27 g/m (2.75 g/in.)

Code 11 electrode: 114.57 g/m (2.91 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma)

Table B2
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E6013 covered electrodes

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ of electrode used x100	Melting rate		Deposition rate		Wgt. of fume/ deposited metal		Weight of fume/ length of electrode used	
			Measured g/min	Normalized g/min/l ^{1/2} x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
E6013	3	24	160	0.58	2.26	1.92	4.22	1.32	2.91	26.33	2.17	0.06	0.06
E6013	3	25	160	0.58	2.27	1.92	4.23	1.37	3.01	25.44	2.20	0.06	0.06
E6013	3	25	160	0.58	2.27	1.97	4.33	1.37	3.01	25.48	2.18	0.06	0.06
			Avg	0.58	2.27	1.94	4.26	1.35	2.98	25.75	2.19	0.06	0.06
			SD	>0.01	>0.01	0.03	0.06	0.03	0.06	0.51	0.02	0.00	0.00
E6013	4	20	150	0.46	2.03	1.68	3.69	1.18	2.59	23.27	1.94	0.05	0.05
E6013	4	23	150	0.49	2.16	1.71	3.77	1.22	2.68	23.89	2.01	0.05	0.05
E6013	4	20	155	0.49	2.06	1.83	4.02	1.32	2.91	22.48	1.93	0.05	0.05
			Avg	0.48	2.08	1.74	3.83	1.24	2.73	23.21	1.96	0.05	0.05
			SD	0.02	0.07	0.08	0.17	0.07	0.16	0.71	0.05	0.00	0.00
E6013	6	---	152	0.32	1.39	1.87	4.12	1.36	2.99	14.25	1.34	0.03	0.03
E6013	6	22	147	0.31	1.41	1.86	4.10	1.34	2.95	13.77	1.26	0.03	0.03
E6013	6	24	150	0.31	1.40	1.86	4.10	1.30	2.87	14.45	1.31	0.03	0.03
			Avg	0.31	1.40	1.86	4.10	1.33	2.93	14.16	1.31	0.03	0.03
			SD	>0.01	>0.01	0.01	0.02	0.03	0.06	0.35	0.04	0.00	0.00

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 3, 4, and 6 electrodes: 3.81 mm/s (9 in./min)

Electrode weight: Code 3 electrode: 122.05 g/m (3.10 g/in.)
Code 4 electrode: 117.32 g/m (2.98 g/in.)
Code 6 electrode: 133.86 g/m (3.40 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B3
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E7018 covered electrodes

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/wgt. of electrode used x100	Melting rate		Deposition rate		Wgt. of fume/ wgt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
			Measured g/min	Normalized g/min/l 2x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E7018	5	24	0.57	1.78	1.64	2.12	4.66	---	---	---	2.43	0.06
E7018	5	23	0.56	1.74	1.51	2.25	4.95	---	---	---	2.39	0.06
E7018	5	24	0.58	1.90	1.64	2.12	4.67	---	---	---	2.45	0.06
E7018	5	23	0.58	1.78	1.60	2.16	4.78	1.68	3.70	20.59	2.44	0.06
			Avg 0.57 SD >0.01	1.80 0.07	Avg 1.60 SD 0.06	2.17 0.06	4.77 0.13	---	---	Avg 2.43 SD 0.05	2.43	0.06
E7018	10	23	0.59	2.16	1.57	2.25	4.96	---	---	---	2.31	0.06
E7018	10	23	0.58	2.00	1.57	2.21	4.87	---	---	---	2.30	0.06
E7018	10	22	0.58	1.90	1.53	2.28	5.02	---	---	---	2.29	0.06
E7018	10	23	0.58	1.90	1.49	2.35	5.16	1.71	3.77	20.35	2.25	0.06
			Avg 0.58 SD >0.01	1.99 0.12	Avg 1.54 SD 0.04	2.27 0.06	5.00 0.12	---	---	Avg 2.28 SD 0.03	2.28	0.06
E7018	12	23	0.60	2.07	1.63	2.21	4.85	---	---	---	2.46	0.06
E7018	12	24	0.60	2.09	1.64	2.21	4.85	---	---	---	2.49	0.06
E7018	12	23	0.61	1.98	1.65	2.21	4.87	---	---	---	2.48	0.06
E7018	12	23	0.60	2.07	1.62	2.21	4.87	1.65	3.62	21.83	2.42	0.06
			Avg 0.60 SD >0.01	2.05 0.05	Avg 1.64 SD 0.01	2.21 0.00	4.86 0.01	---	---	Avg 2.46 SD 0.03	2.46	0.06

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 5, 10, and 12 electrodes: 3.92 mm/s (9.25 in./min)

Electrode weight:

Code 5 electrode: 148.42 g/m (3.77 g/in.)
Code 10 electrode: 148.42 g/m (3.77 g/in.)
Code 12 electrode: 145.57 g/m (3.70 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma)

Table B4
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E7024 covered electrodes

Electrode	Code	Voltage, V		Current, A	Fume generation rate		Wgt. of fume/wgt. of electrode used		Melting rate		Deposition rate		Wgt. of fume/wgt. of deposited metal		Weight of fume/length of electrode used	
		avg		avg	Measured g/min	Normalized g/min/I ² × 10 ⁻⁵	Measured x 100	SD	kg/h	lb/h	kg/h	lb/h	g/kg*		g/m	g/in.
E7024	7	39		200	0.55	1.38	0.67		4.97	10.93	---	---	---		1.72	0.04
E7024	7	40		220	0.52	1.08	0.62		5.05	11.10	---	---	---		1.61	0.04
E7024	7	41		220	0.54	1.11	0.64		5.08	11.17	---	---	---		1.65	0.04
E7024	7	38		210	0.55	1.25	0.77		4.29	9.43	2.97	6.54	11.11		1.63	0.04
					Avg 0.54	1.21	Avg 0.67		4.84	10.66				Avg 1.65	0.04	
					SD 0.01	0.13	SD 0.07		0.37	0.82				SD 0.05	0.00	
E7024	8	38		225	0.54	1.06	0.63		5.08	11.18	---	---	---		2.05	0.05
E7024	8	38		225	0.54	1.07	0.65		5.02	11.04	---	---	---		2.05	0.05
E7024	8	35		230	0.56	1.05	0.68		4.92	10.82	---	---	---		2.13	0.05
E7024	8	41		205	0.57	1.35	0.72		4.78	10.51	3.27	7.20	10.43		2.17	0.05
					Avg 0.55	1.13	Avg 0.67		4.95	10.89				Avg 2.10	0.05	
					SD 0.01	0.15	SD 0.04		0.13	0.29				SD 0.06	0.00	
E7024	9	39		210	0.42	0.96	0.63		4.02	8.85	---	---	---		1.67	0.04
E7024	9	36		215	0.41	0.89	0.61		4.02	8.84	---	---	---		1.61	0.04
E7024	9	37		210	0.42	0.96	0.62		4.08	8.97	---	---	---		1.66	0.04
E7024	9	41		205	0.47	1.11	0.64		4.39	9.66	3.14	6.90	8.92		1.80	0.04
					Avg 0.43	0.98	Avg 0.63		4.13	9.08				Avg 1.69	0.04	
					SD 0.02	0.09	SD 0.01		0.18	0.39				SD 0.08	0.00	

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 7 electrode: 466 mm/s (11 in./min)

Code 8 and 9 electrodes: 3.60 mm/s (8.5 in./min)

Electrode weight:

Code 7 electrode: 214.96 g/m (\$46 g/in.)

Code 8 electrode: 215.75 g/m (\$48 g/in.)

Code 9 electrode: 205.51 g/m (\$22 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B5
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E8018C3 covered electrodes

Electrode	Code	Voltage, V	Current, A	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
		avg	avg	Measured g/min	Normalized g/min/[I ² x10 ⁻⁵]		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E8018C3	13	22	160	0.45	1.74	1.21	2.22	4.88	1.51	3.32	17.74	1.81	0.05
E8018C3	13	24	158	0.44	1.77	1.22	2.15	4.73	1.47	3.24	17.88	1.81	0.05
E8018C3	13	23	160	0.45	1.74	1.23	2.18	4.79	1.50	3.30	17.83	1.81	0.05
				Avg 0.44	1.75	1.22	2.18	4.80	1.49	3.29	17.82	1.81	0.05
				SD >0.01	0.01	SD 0.01	SD 0.03	0.07	SD 0.02	0.04	SD 0.07	SD 0.00	>0.01
E8018C3	14	23	175	0.46	1.52	1.28	2.18	4.79	---	---	---	1.91	0.05
E8018C3	14	23	175	0.46	1.51	1.27	2.19	4.81	---	---	---	1.89	0.05
E8018C3	14	23	175	0.49	1.59	1.33	2.19	4.82	---	---	---	2.00	0.05
E8018C3	14	23	178	0.47	1.54	1.31	2.16	4.76	1.52	3.34	18.69	1.95	0.05
				Avg 0.47	1.54	1.30	2.18	4.80	---	---	---	1.94	0.05
				SD 0.01	0.03	SD 0.03	SD 0.01	0.03	---	---	---	SD 0.05	>0.01
E8018C3	15	23	165	0.42	1.55	1.11	2.22	4.89	1.56	3.44	16.19	1.70	0.04
E8018C3	15	23	165	0.44	1.61	1.19	2.19	4.82	1.62	3.57	16.08	1.80	0.05
E8018C3	15	23	165	0.43	1.60	1.19	2.19	4.83	1.68	3.70	15.50	1.77	0.04
				Avg 0.43	1.58	1.16	2.20	4.85	1.62	3.57	15.92	1.76	0.04
				SD 0.01	0.03	SD 0.04	SD 0.02	0.04	SD 0.06	0.13	SD 0.37	SD 0.05	>0.01

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 13 electrode: 3.39 mm/s (8 in./min)

Code 14 electrode: 3.81 mm/s (9 in./min)

Code 15 electrode: 4.28 mm/s (10.1 in./min)

Electrode weight/unit length:

Code 13 electrode: 147.71 g/m (3.75 g/in.)

Code 14 electrode: 150.50 g/m (3.82 g/in.)

Code 15 electrode: 151.30 g/m (3.84 g/in.)

The deposition rate for the Code 14 electrode was determined in only one experimental test.

SD: standard deviation (sigma)

Table B6
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E9018B3 covered electrodes

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h	Deposition rate kg/h	Deposition rate lb/h	Wgt. of fume/ wgt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
			Measured g/min	Normalized g/min/l ^{1/2} x10 ⁻⁵						g/m	g/in.
E9018B3	18	23	165	1.33	0.36	2.55	1.96	5.61	11.02	1.33	0.03
E9018B3	18	23	165	1.32	0.36	2.54	1.90	5.58	11.21	1.32	0.03
E9018B3	18	23	165	1.33	0.36	2.53	1.90	5.58	11.33	1.34	0.03
			Avg 0.36 SD >0.01	1.33 0.01	Avg 0.85 SD >0.01	2.54 0.01	1.92 0.03	5.59 0.02	11.19 0.16	Avg 1.33 SD 0.01	0.03 >0.01
E9018B3	17	24	175	1.46	0.46	2.28	1.85	5.01	14.89	1.72	0.04
E9018B3	17	24	180	1.45	0.46	2.22	1.80	4.89	15.18	1.76	0.04
E9018B3	17	24	180	1.47	0.47	2.35	1.88	5.17	14.75	1.69	0.04
			Avg 0.46 SD >0.01	1.46 0.01	Avg 1.22 SD 0.02	2.28 0.06	1.84 0.04	5.03 0.14	14.94 0.22	Avg 1.73 SD 0.03	0.04 >0.01
E9018B3	16	22	160	1.53	0.39	2.19	1.74	4.81	13.51	1.55	0.04
E9018B3	16	21	163	1.51	0.40	2.31	1.74	5.08	13.71	1.49	0.04
E9018B3	16	22	165	1.51	0.40	2.23	1.77	4.91	13.55	1.55	0.04
E9018B3	16	22	160	1.56	0.40	2.21	1.77	4.86	13.54	1.55	0.04
			Avg 0.40 SD >0.01	1.53 0.02	Avg 1.07 SD 0.02	2.23 0.05	1.76 0.02	4.91 0.12	13.58 0.09	Avg 1.54 SD 0.03	0.04 >0.01

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 18 electrode: 4.23 mm/s (10 in./min)

Code 17 electrode: 3.81 mm/s (9 in./min)

Code 16 electrode: 3.39 mm/s (8 in./min)

Electrode weight/unit length: Code 18 electrode: 149.74 g/m (3.80 g/in.)

Code 17 electrode: 143.31 g/m (3.64 g/in.)

Code 16 electrode: 144.88 g/m (3.68 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B7
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E316-15 covered electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used $\times 100$	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal	Weight of fume/ length of electrode used	
				Measured g/min	Normalized g/min/I ² $\times 10^{-5}$		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E316-15	22	25	148	0.31	1.43	0.71	2.62	5.77	1.81	4.03	10.19	0.94	0.02
E316-15	22	25	148	0.32	1.47	0.73	2.62	5.77	1.88	4.18	10.14	0.97	0.02
E316-15	22	25	148	0.32	1.47	0.73	2.62	5.77	1.79	3.98	10.65	0.97	0.02
				Avg	1.46	0.73	2.62	5.77	1.83	4.06	10.32	Avg	0.96
				SD	0.01	0.01	0.00	>0.01	SD	0.11	SD	0.02	>0.01
E316-15	27	29	155	0.37	1.55	0.77	2.92	6.42	1.99	4.49	11.13	1.08	0.03
E316-15	27	29	155	0.37	1.55	0.76	2.92	6.42	1.98	4.41	11.18	1.08	0.03
E316-15	27	29	155	0.38	1.53	0.78	2.92	6.42	2.07	4.59	10.93	1.10	0.03
				Avg	1.54	0.77	2.92	>0.01	Avg	4.59	11.08	Avg	1.09
				SD	0.01	0.01	0.00	>0.01	SD	0.10	SD	0.01	>0.01
E316-15	19	25	150	0.28	1.22	0.64	2.57	5.66	2.04	4.49	8.10	0.82	0.02
E316-15	19	25	150	0.27	1.24	0.63	2.60	5.72	2.10	4.61	7.79	0.80	0.02
E316-15	19	25	150	0.28	1.24	0.65	2.57	5.66	2.05	4.54	8.17	0.82	0.02
				Avg	1.22	0.64	2.58	5.68	2.06	4.54	8.02	Avg	0.81
				SD	0.01	0.01	0.02	0.04	SD	0.07	SD	0.01	>0.01

*g/kg ± 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Direct current: electrode positive

Welding speed: Code 19 electrode: 4.23 mm/s (10 in./min)

Code 22 electrode: 5.08 mm/s (12 in./min)

Code 27 electrode: 3.81 mm/s (9 in./min)

Electrode weight/unit length: Code 19 electrode: 145.26 g/m (3.69 g/in.)

Code 22 electrode: 132.28 g/m (3.36 g/in.)

Code 27 electrode: 141.73 g/m (3.60 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B8
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E316-16 covered electrodes

Electrode Code	Voltage, V	Current, A	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal	Weight of fume/ length of electrode used	
			Measured	Normalized		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E316-16	26	22	150	0.20	0.89	2.59	5.72	1.89	4.17	6.33	0.59	0.01
E316-16	26	23	150	0.22	0.97	2.60	5.71	1.90	4.18	6.92	0.67	0.02
E316-16	26	23	150	0.20	0.91	2.60	5.72	1.90	4.19	6.43	0.63	0.02
				Avg	0.21	Avg	5.72	Avg	4.18	Avg	0.63	0.02
				SD	0.01	SD	0.01	SD	0.01	SD	0.04	>0.01
E316-16	20	24	150	0.31	1.39	2.53	5.57	1.57	3.46	11.98	0.95	0.02
E316-16	20	25	150	0.30	1.34	2.53	5.57	1.59	3.49	11.44	0.91	0.02
E316-16	20	24	150	0.31	1.38	2.52	5.55	1.50	3.31	12.34	0.94	0.02
				Avg	0.31	Avg	5.56	Avg	3.42	Avg	0.93	0.02
				SD	0.01	SD	0.01	SD	0.10	SD	0.02	0.00
E316-16	25	23	147	0.24	1.14	2.53	5.56	1.70	3.74	8.70	0.85	0.02
E316-16	25	24	147	0.25	1.16	2.52	5.55	1.74	3.83	8.50	0.85	0.02
E316-16	25	23	147	0.25	1.15	2.53	5.56	1.80	3.96	8.32	0.86	0.02
				Avg	0.25	Avg	5.56	Avg	3.84	Avg	0.85	0.02
				SD	0.01	SD	0.01	SD	0.11	SD	0.01	0.00

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Welding speed: Code 26 electrode: 4.44 mm/s (10.5 in./min)
Code 20 and 25 electrodes: 4.23 mm/s (10 in./min)

Electrode weight:

Code 26 electrode: 132.68 g/m (3.37 g/in.)
Code 20 electrode: 127.07 g/m (3.23 g/in.)
Code 25 electrode: 145.26 g/m (3.68 g/in.)

Metal deposition rate determined for only 1 test per electrode
SD: standard deviation (sigma)

170/FUMES AND GASES

Table B9
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E410-16 covered electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used $\times 100$	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
				Measured g/min	Normalized g/min/ $1/2 \times 10^{-5}$		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E410-16	21	23	145	0.34	1.61	0.98	2.06	4.53	1.42	3.14	14.17	1.33	0.03
E410-16	21	25	145	0.32	1.54	0.94	2.06	4.53	1.42	3.13	13.58	1.27	0.03
E410-16	21	25	145	0.33	1.58	0.97	2.06	4.53	1.41	3.11	14.15	1.31	0.03
				Avg 0.33	1.58	Avg 0.96	2.06	4.53	1.42	3.13	Avg 13.97	Avg 1.30	0.03
				SD 0.01	0.03	SD 0.03	0.02	>0.01	0.01	0.02	SD 0.33	SD 0.03	0.01
E410-16	23	22	158	0.29	1.17	0.82	2.12	4.66	1.47	3.24	11.80	1.11	0.03
E410-16	23	22	158	0.28	1.13	0.79	2.12	4.66	1.44	3.17	11.66	1.06	0.03
E410-16	23	22	158	0.28	1.15	0.81	2.11	4.64	1.45	3.20	11.78	1.08	0.03
				Avg 0.28	1.15	Avg 0.81	2.12	4.65	1.46	3.20	Avg 11.75	Avg 1.08	0.03
				SD >0.01	0.02	SD 0.01	0.01	>0.01	0.02	0.03	SD 0.08	SD 0.03	>0.01
E410-16	24	21	155	0.34	1.42	0.91	2.23	4.94	1.40	3.29	13.68	1.26	0.03
E410-16	24	22	158	0.33	1.35	0.90	2.24	4.93	1.47	3.22	13.71	1.28	0.03
E410-16	24	22	158	0.34	1.37	0.91	2.22	4.89	1.45	3.18	14.04	1.33	0.03
				Avg 0.34	1.37	Avg 0.91	2.24	4.92	1.47	3.23	Avg 13.81	Avg 1.29	0.03
				SD >0.01	0.37	SD 0.01	0.01	0.03	0.02	0.05	SD 0.20	SD 0.04	>0.01

*g/kg $\div 10$ = weight of fume expressed as a percentage of the deposit weight

Notes:

Direct current: electrode positive

Welding speed: Code 21 electrode: 4.02 mm/s (9.5 in./min)

Code 23 electrode: 4.23 mm/s (10 in./min)

Code 24 electrode: 3.39 mm/s (8 in./min)

Electrode weight/unit length: Code 21 electrode: 134.10 g/m (3.41 g/in.)

Code 23 electrode: 135.10 g/m (3.43 g/in.)

Code 24 electrode: 137.82 g/m (3.50 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B10
Fume generation characteristics of 3.97 mm (5/32 in.) diameter high alloy covered electrodes

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
			Measured g/min	Normalized g/min/1 ² x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in
ENI-CI	28	21	0.36	1.97	1.18	1.83	4.02	1.68	3.69	12.78	1.57	0.04
ENI-CI	28	21	0.36	1.98	1.20	1.80	3.96	1.70	3.74	12.74	1.57	0.04
ENI-CI	28	21	0.38	2.06	1.26	1.79	3.93	1.71	3.77	13.18	1.63	0.04
			Avg	2.01	1.22	1.81	3.97	1.70	3.73	12.90	Avg	0.04
			SD	0.05	0.04	0.02	0.05	0.02	0.04	SD	SD	>0.01
ENI-Cu-2	33	25	0.31	1.52	0.74	2.51	5.52	1.80	3.96	10.29	1.02	0.03
ENI-Cu-2	33	27	0.31	1.51	0.73	2.51	5.52	1.85	4.07	9.94	1.02	0.03
ENI-Cu-2	33	27	0.31	1.52	0.74	2.51	5.52	1.85	4.07	10.01	1.02	0.03
			Avg	1.52	0.74	2.51	5.52	1.83	4.04	10.08	Avg	0.03
			SD	0.01	0.01	0.00	>0.01	0.02	0.06	SD	SD	>0.01
Inconel 625	62	24	0.32	1.35	0.71	2.75	6.06	2.07	4.56	9.36	0.97	0.02
Inconel 625	62	26	0.31	1.61	0.68	2.78	6.13	2.10	4.61	9.00	0.93	0.02
Inconel 625	62	26	0.32	1.54	0.70	2.78	6.11	2.08	4.59	9.34	0.96	0.02
			Avg	1.50	0.70	2.77	6.10	2.08	4.59	9.24	Avg	0.02
			SD	0.01	0.01	0.02	0.04	0.01	0.03	SD	SD	>0.01
Haynes C-276	69	24	0.37	0.06	0.98	2.27	5.00	1.56	3.44	14.20	1.51	0.04
Haynes C-276	69	22	0.37	0.07	0.98	2.26	4.97	1.56	3.44	14.20	1.40	0.04
Haynes C-276	69	23	0.37	0.07	0.98	2.26	4.98	1.56	3.44	14.20	1.50	0.04
			Avg	0.07	0.98	2.26	4.98	1.56	3.44	14.20	Avg	0.04
			SD	0.01	0.00	0.01	0.02	0.00	0.00	SD	SD	>0.01
Haynes 25	70	19	0.26	0.05	0.66	2.37	5.22	1.74	3.82	8.98	0.98	0.02
Haynes 25	70	19	0.26	0.05	0.64	2.44	5.37	1.75	3.86	8.89	0.97	0.02
Haynes 25	70	19.5	0.26	0.05	0.66	2.37	5.21	1.74	3.83	8.96	0.97	0.02
			Avg	0.05	0.65	2.40	5.27	1.74	3.84	8.94	Avg	0.02
			SD	0.00	0.01	0.04	0.09	0.01	0.02	SD	SD	>0.01

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Direct current: electrode positive

Welding speed:

Code 28 electrode: 3.81 mm/s (9 in./min)
 Code 33 electrode: 5.93 mm/s (14 in./min)
 Inconel 625 electrode: 4.23 mm/s (10 in./min)
 Code 69 electrode: 4.02 mm/s (9.5 in./min)
 Code 70 electrode: 4.45 mm/s (10.5 in./min)

Electrode weight/unit length: Code 28 electrode: 131.42 g/m (3.34 g/in.)
 Code 33 electrode: 138.68 g/m (3.52 g/in.)
 Inconel 625 electrode: 138.97 g/m (3.53 g/in.)
 Code 69 electrode: 133.76 g/m (3.90 g/in.)
 Code 70 electrode: 150.10 g/m (3.81 g/in.)

Compositions:

ENI-CI: 2C-4Si-1Mn-8Fe-2.5Cu-85Ni
 ENI-Cu-2: 6Mn-1.5Si-2.3Fe-60 to 68 Ni-1Al-1Ti-3(Cb+Ta)-Bal.Cu
 Inconel 625: 61Ni-0.25Mn-0.25Si-2.5Fe-21.5C-0.2Al-0.2Ti-9Mo-3.65(Cb+Ta)
 Haynes C-276: 2.5Co-16Cr-16Mo-4W-5Fe-0.08Si-1Mn-2Cu-2(Cb+Ta)-Bal.Ni
 Haynes 25: 10Ni-20Cr-15W-3Fe-1Si-1Mn-Bal.Co

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

172/FUMES AND GASES

Table B11
Fume generation characteristics of 2.38 mm (3/32 in.) diameter E70T-1 flux cored electrodes (CO₂ shielding)

Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	Wire feed rate in./min	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal	Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/l 2x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
40	30	485	87.63	207	1.36	0.58	0.91	8.95	19.70	7.72	17.15	10.44	0.26	0.01
40	31	485	87.63	207	1.34	0.57	0.90	8.95	19.70	7.70	17.10	10.37	0.26	0.01
40	31	470	87.63	207	1.36	0.61	0.91	8.95	19.70	7.77	17.27	10.38	0.26	0.01
					Avg	0.59	Avg							
					SD	0.02	SD							
42	30	445	87.00	205.5	2.28	1.15	1.56	8.80	19.36	7.84	17.42	17.31	0.44	0.01
42	31	435	87.00	205.5	2.25	1.19	1.54	8.80	19.36	7.60	16.89	17.60	0.44	0.01
42	31	440	87.00	205.5	2.28	1.18	1.56	8.80	19.36	7.68	17.07	17.63	0.44	0.01
					Avg	1.17	Avg							
					SD	0.02	SD							
41	31	460	87.00	205.5	0.96	0.45	0.62	9.29	20.43	8.53	18.95	6.68	0.19	>0.01
41	30	465	87.00	205.5	0.96	0.44	0.62	9.29	20.43	8.67	19.27	6.66	0.19	>0.01
41	30	455	87.00	205.5	0.96	0.46	0.62	9.29	20.43	8.61	19.14	6.16	0.19	>0.01
					Avg	0.45	Avg							
					SD	0.01	SD							
46	30	435	88.90	210	1.33	0.70	0.90	8.84	19.45	7.92	17.60	9.95	0.25	0.01
46	31	435	88.90	210	1.33	0.70	0.90	8.84	19.45	7.95	17.66	9.95	0.25	0.01
46	31	445	88.90	210	1.33	0.67	0.90	8.84	19.45	7.88	17.50	10.02	0.25	0.01
					Avg	0.69	Avg							
					SD	0.02	SD							
47	30	435	88.90	210	1.83	0.97	1.21	9.10	20.03	7.62	16.94	14.25	0.34	0.01
47	31	435	88.90	210	1.83	0.97	1.21	9.10	20.03	7.68	17.07	14.15	0.34	0.01
47	30	435	88.90	210	1.83	0.97	1.21	9.10	20.03	7.72	17.15	14.11	0.34	0.01
					Avg	0.97	Avg							
					SD	>0.01	SD							

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 38 mm (1-1/2 in.)

Welding time: 30 s

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: Code No. 40: 28.35 g/m (0.72 g/in.)
 Code No. 41: 29.53 g/m (0.75 g/in.)
 Code No. 42: 27.95 g/m (0.71 g/in.)
 Code No. 46: 27.56 g/m (0.70 g/in.)
 Code No. 47: 28.35 g/m (0.72 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B12
Fume generation characteristics of 2.38 mm (3/32 in.) diameter E70T-4 self-shielded flux cored electrodes

Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	in./min	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Metal deposition rate	Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/l ⁻¹ x10 ⁻⁵		kg/h	lb/h		g/kg*	lb/h	g/m	g/in.
48	31	390	93.98	222	2.96	1.95	1.91	9.30	20.47	7.70	22.85	17.10	0.52	0.01
48	32	385	93.98	222	2.99	2.02	1.93	9.30	20.47	7.86	22.59	17.47	0.53	0.01
48	32	385	93.98	222	2.98	2.01	1.92	9.30	20.47	7.80	22.66	17.34	0.53	0.01
					Avg 2.98 SD 0.02	1.99 0.04	Avg 1.92 SD 0.01		Avg 7.79 SD 0.08	17.30	Avg 22.70 SD 0.13			
56	29	370	91.86	217	1.76	1.29	1.13	9.37	20.62	8.41	12.56	18.50	0.32	0.01
56	30	390	96.94	229	1.88	1.23	1.14	9.89	21.76	8.80	12.83	19.35	0.32	0.01
56	30	390	96.94	229	1.89	1.24	1.15	9.89	21.76	8.89	12.78	19.56	0.33	0.01
56	31	390	96.94	229	1.90	1.25	1.15	9.89	21.76	8.85	12.87	19.48	0.33	0.01
					Avg 1.86 SD 0.07	1.25 0.03	Avg 1.14 SD 0.01		Avg 8.74 SD 0.22	19.22	Avg 12.76 SD 0.13		Avg 0.33 SD 0.01	0.01
49	31	400	113.03	267	2.00	1.25	1.17	10.29	22.63	8.93	13.28	19.85	0.29	0.01
49	32	400	113.03	267	2.18	1.36	1.27	10.29	22.63	9.02	14.35	20.04	0.32	0.01
49	31	410	113.03	267	2.10	1.25	1.23	10.29	22.63	9.00	13.85	20.01	0.31	0.01
					Avg 2.09 SD 0.09	1.29 0.07	Avg 1.22 SD 0.05		Avg 8.99 SD 0.05	19.97	Avg 13.83 SD 0.53			

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: Positive

Electrode contact tube-to-work distance: 70 mm (2-3/4 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: Code No. 48: 27.56 g/m (0.70 g/in.)

Code No. 49: 25.20 g/m (0.64 g/in.)

Code No. 56: 27.95 g/m (0.71 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma)

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Table B13
Fume generation characteristics of 2.38 mm (3/32 in.) diameter E70T-5 flux cored electrodes (CO₂ shielding)

Manu- Code	Voltage, V avg	Current, A avg	Wire feed rate		Fume gener- ation rate		Wgt. of fume/ electrode used x 100	Melting rate		Metal deposition rate		Wgt. of fume/ wgt. of deposited metal	Wgt. of fume/ length of electrode used	
			mm/s	in./min	Measured g/min	Normalized g/min/1/2 x 10 ⁻³		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
44	30	425	87.63	207	2.27	1.26	1.55	8.95	19.70	7.59	16.86	17.77	0.43	0.01
44	31	445	87.63	207	2.26	1.14	1.54	8.95	19.70	7.47	16.60	17.95	0.43	0.01
44	31	445	87.63	207	2.26	1.14	1.54	8.95	19.70	7.51	16.68	17.88	0.43	0.01
					Avg 2.26 SD 0.01	1.18 0.07	Avg 1.54 SD >0.01			Avg 7.52 SD 0.06	16.71	Avg 17.87 SD 0.09		
50	31	440	93.98	222	3.26	1.68	2.08	9.40	20.67	8.19	18.21	23.63	0.58	0.01
50	30	440	93.98	222	3.25	1.68	2.07	9.40	20.67	8.16	18.13	23.66	0.58	0.01
50	31	450	93.98	222	3.25	1.61	2.08	9.40	20.67	8.19	18.21	23.59	0.58	0.01
					Avg 3.25 SD >0.01	1.66 0.04	Avg 2.08 SD >0.01			Avg 8.18 SD 0.02	18.18	Avg 23.63 SD 0.04		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 38 mm (1-1/2 in.)

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: Code No. 44: 27.95 g/m (0.71 g/in.)

Code No. 50: 27.56 g/m (0.70 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B14
Fume generation characteristics of 2.38 mm (3/32 in.) diameter alloy steel flux cored electrodes (CO₂ shielding)

Electrode	Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	Wire feed rate in./min	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Metal deposition rate	Wgt. of fume/ wt. of deposited metal	Wgt. of fume/ length of electrode used	
						Measured g/min	Normalized g/min/l x 10 ⁻⁵		kg/h	lb/h		g/kg*	g/m	g/in.
81-C3	51	30.5	440	92.71	219	1.08	0.56	0.72	9.04	19.89	7.53	16.73	8.50	0.20
81-C3	51	30.5	440	92.71	219	1.12	0.57	0.74	9.04	19.89	7.59	16.86	8.69	0.20
81-C3	52	30.5	445	92.71	219	1.12	0.57	0.75	9.04	19.89	7.55	16.78	8.82	0.20
						Avg 1.11 SD 0.02	0.57	Avg 0.73 SD 0.01			Avg 7.56 SD 0.03	Avg 8.69 SD 0.13		
91-B3	52	30.5	450	104.14	246	1.15	0.57	0.74	9.42	20.73	8.07	17.97	8.47	0.18
91-B3	52	30.5	450	104.14	246	1.14	0.57	0.73	9.42	20.73	8.11	18.03	8.37	0.18
91-B3	52	30.5	450	104.14	246	1.15	0.57	0.73	9.42	20.73	8.09	17.97	8.43	0.18
						Avg 1.15 SD >0.01	0.57	Avg 0.73 SD >0.01			Avg 8.09 SD 0.01	Avg 8.42 SD 0.05		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 38 mm (1-1/2 in.)

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h) CO₂

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: Code No. 51: 27.17 g/m (0.69 g/in.)

Code No. 52: 25.20 g/m (0.64 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B16
Fume generation characteristics of 1.14 mm (0.045 in.) diameter E70S-3 gas metal arc electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s in./min	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used		
					Measured g/min	Normalized g/min/l ^{1/2} x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.	
Spray transfer with Ar-2 O ₂ shielding															
E70S-3	54	35	275	171.87	406	0.41	0.54	0.49	5.01	11.02	4.93	10.84	4.99	0.04	<0.01
E70S-3	54	35	275	171.87	406	0.41	0.53	0.49	5.01	11.02	4.93	10.84	5.02	0.04	<0.01
E70S-3	54	34	260	171.87	406	0.40	0.59	0.48	5.01	11.02	4.86	10.70	4.91	0.04	<0.01
						Avg 0.41	0.56	0.49		Avg 4.91		10.79	Avg 4.97		
						SD 0.01	0.03	SD 0.01		SD 0.03		0.08	SD 0.06		
Spray transfer with Ar-9 CO ₂ shielding															
E70S-3	54	33	210	132.50	313	0.42	0.95	0.65	3.86	8.50	3.84	8.46	6.52	0.05	<0.01
E70S-3	54	33	215	132.50	313	0.41	0.88	0.63	3.86	8.50	3.86	8.48	6.32	0.05	<0.01
E70S-3	54	33	210	132.50	313	0.41	0.92	0.63	3.86	8.50	3.84	8.46	6.33	0.05	<0.01
						Avg 0.41	0.92	0.64		Avg 3.85		8.47	Avg 6.39		
						SD 0.01	0.04	SD 0.01		SD 0.01		0.01	SD 0.11		
Globular transfer with CO ₂ shielding															
E70S-3	54	37	328	321.73	760	0.48	0.45	0.31	9.38	20.64	9.30	20.46	3.13	0.03	<0.01
E70S-3	54	36	340	321.73	760	0.52	0.45	0.33	9.38	20.64	9.32	20.51	3.34	0.03	<0.01
E70S-3	54	36	338	321.73	760	0.53	0.46	0.34	9.38	20.64	9.35	20.56	3.38	0.03	<0.01
E70S-3	54	36	335	321.73	760	0.53	0.47	0.34	9.38	20.64	9.34	20.54	3.38	0.03	<0.01
						Avg 0.51	0.46	0.33		Avg 9.33		20.52	Avg 3.31		
						SD 0.02	0.01	SD 0.02		SD 0.02		0.04	SD 0.12		
Short circuiting with Ar-2.5 CO ₂ shielding															
E70S-3	54	19.5	195	104.14	246	0.21	0.55	0.43	2.97	6.55	2.96	6.52	4.16	0.03	<0.01
E70S-3	54	19.5	195	104.14	246	0.20	0.53	0.45	2.97	6.55	2.95	6.50	4.07	0.03	<0.01
E70S-3	54	19.5	195	104.14	246	0.20	0.53	0.41	2.97	6.55	2.96	6.52	4.11	0.03	<0.01
						Avg 0.20	0.54	0.43		Avg 4.96		6.51	Avg 4.11		
						SD 0.01	0.01	SD 0.02		SD 0.01		0.01	SD 0.05		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25.4 mm (1 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: 7.92 g/m (0.20 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

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Table B17
Fume generation characteristics of 1.14 mm (0.045 in.) diameter E70S-3 gas metal arc electrodes

Electrode	Code	Voltage, V		Current, A	Wire feed rate		Fume generation rate		Wgt. of fume/ wgt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wgt. of deposited metal	Wgt. of fume/ length of electrode used	
		avg	Code		mm/s	in./min	Measured g/min	Normalized g/min/l ^{1/2} x10 ⁻⁵		kg/h	lb/h	kg/h	lb/h			
Spray transfer with Ar-2 O ₂ shielding																
E70S-3	57	35		290	182.03	430	0.46	0.54	0.54	5.04	11.09	4.87	10.70	5.63	0.04	<0.01
E70S-3	57	35		285	182.03	430	0.46	0.56	0.54	5.04	11.09	4.78	10.52	5.74	0.04	<0.01
E70S-3	57	35		270	182.03	430	0.46	0.64	0.55			4.90	10.78	5.67	0.04	<0.01
							Avg 0.46	0.58	0.54		Avg 4.88	10.67	Avg 5.68			
							SD 0.00	0.05	SD 0.01		SD 0.06	0.15	SD 0.05			
Spray transfer with Ar-9 CO ₂ shielding																
E70S-3	57	34		210	120.23	284	0.44	1.01	0.80	3.32	7.31	3.18	7.00	8.38	0.06	<0.01
E70S-3	57	34		205	120.23	284	0.44	0.99	0.79	3.32	7.31	3.17	6.98	8.31	0.06	<0.01
E70S-3	57	33		210	120.23	284	0.44	1.00	0.80	3.52	7.31	3.20	7.03	8.33	0.06	<0.01
							Avg 0.44	1.00	Avg 0.80		Avg 3.18	7.00	Avg 8.34			
							SD 0.00	0.01	SD 0.01		SD 0.01	0.03	SD 0.01			
Globular transfer with CO ₂ shielding																
E70S-3	57	35		320	312.42	738	0.45	0.44	0.31	8.65	19.03	8.53	18.77	3.16	0.02	<0.01
E70S-3	57	35		325	312.42	738	0.45	0.43	0.31	8.65	19.03	8.51	18.71	3.18	0.02	<0.01
E70S-3	57	35		325	312.42	738	0.48	0.45	0.33			8.53	18.77	3.37	0.02	<0.01
							Avg 0.46	0.44	Avg 0.32		Avg 8.52		18.75	Avg 3.24		
							SD 0.02	0.01	SD 0.01		SD 0.01	0.02	SD 0.11			
Short circuiting with Ar-25 CO ₂ shielding																
E70S-3	57	19.5		205	110.91	262	0.24	0.58	0.48	3.07	6.75	3.05	6.71	4.80	0.04	<0.01
E70S-3	57	19.5		205	110.91	262	0.25	0.59	0.48	3.07	6.75	3.05	6.71	4.87	0.04	<0.01
E70S-3	57	19.5		195	110.91	262	0.26	0.68	0.50	3.07	6.75	3.05	6.71	5.08	0.04	<0.01
							Avg 0.25	0.62	Avg 0.49		Avg 3.05		6.71	Avg 4.91		
							SD 0.01	0.06	SD 0.01		SD 0.00	0.00	SD 0.15	SD 0.00		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25 mm (1 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas flow rate: 21.24 liters/min (45-50 ft³/h)

Electrode weight: 7.92 g/m (0.20 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B18
Fume generation characteristics of 1.14 mm (0.045 in.) diameter E70S-3 gas metal arc electrodes

Electrode Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s in./min	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used		
				Measured g/min	Normalized g/min/I ^{0.5}		kg/h	lb/h	kg/h	lb/h		g/m	g/in.	
Spray transfer with Ar-2 O ₂ shielding														
E70S-3	34	290	173.57	410	0.46	0.54	0.57	4.82	10.61	4.81	10.57	5.70	0.05	<0.01
E70S-3	35	280	173.57	410	0.46	0.39	0.57	4.82	10.61	4.81	10.59	5.67	0.05	<0.01
E70S-3	34	285	173.57	410	0.44	0.54	0.55	4.82	10.61	4.81	10.57	5.48	0.05	<0.01
					Avg 0.45 SD 0.01	0.56	Avg 0.56 SD 0.01			Avg 4.81 SD 0.00	10.58	Avg 5.61 SD 0.12		
Spray transfer with Ar-9 CO ₂ shielding														
E70S-3	33	225	137.80	326	0.48	0.95	0.74	3.93	8.65	3.77	8.30	7.63	0.06	<0.01
E70S-3	33	225	137.80	326	0.50	0.98	0.76	3.93	8.65	3.80	8.35	7.90	0.06	<0.01
E70S-3	33	220	137.80	326	0.48	0.99	0.74	3.93	8.65	3.84	8.46	7.49	0.06	<0.01
					Avg 0.49 SD 0.01	0.97	Avg 0.75 SD 0.01			Avg 3.80 SD 0.04	8.37	Avg 7.67 SD 0.21		
Globular transfer with CO ₂ shielding														
E70S-3	33	320	312.42	738	0.50	0.49	0.34	8.92	19.63	8.77	19.30	3.41	0.02	<0.01
E70S-3	32	330	312.42	738	0.44	0.40	0.29	8.92	19.63	8.85	19.48	2.96	0.02	<0.01
E70S-3	32	330	312.42	738	0.43	0.39	0.29	8.92	19.63	8.83	19.43	2.91	0.02	<0.01
					Avg 0.45 SD 0.04	0.43	Avg 0.31 SD 0.03			Avg 8.82 SD 0.04	19.40	Avg 3.09 SD 0.28		
Short circuiting with Ar-25 CO ₂ shielding														
E70S-3	19	205	107.31	253	0.24	0.58	0.48	3.06	6.74	2.98	6.56	4.88	0.04	<0.01
E70S-3	19	200	107.31	253	0.24	0.60	0.47	3.06	6.74	2.94	6.48	4.88	0.04	<0.01
E70S-3	19.5	200	107.31	253	0.24	0.59	0.46	3.06	6.74	2.94	6.47	4.80	0.04	<0.01
					Avg 0.24 SD 0.00	0.59	Avg 0.47 SD 0.01			Avg 2.95 SD 0.03	6.50	Avg 4.85 SD 0.05		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25.4 mm (1 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: 7.92 g/m (0.20 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

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Table B19
Fume generation characteristics of 1.14 mm (0.045 in.) diameter E70S-5 gas metal arc electrodes

Electrode Code	Voltage, V avg		Current, A avg		Wire feed rate mm/s in./min		Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate kg/h lb/h		Deposition rate kg/h lb/h		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
							Measured g/min	Normalized g/min/l $\sqrt{A \times 10^{-5}}$							g/m	g/in.
Spray transfer with Ar-2 O ₂ shielding																
E70S-5 59	34	275	158.75	375	0.38	0.50	0.49	4.62	10.15	4.56	10.07	4.98	0.04	<0.01	<0.01	
E70S-5 59	34	275	158.75	375	0.39	0.52	0.51	4.62	10.15	4.60	10.12	5.09	0.04	<0.01	<0.01	
E70S-5 59	34	290	158.75	375	0.38	0.45	0.49	4.62	10.15	4.60	10.11	4.98	0.04	<0.01	<0.01	
					Avg 0.38 SD 0.01	0.49 0.04	Avg 0.50 SD 0.01			Avg 4.59 SD 0.01	10.10 0.03	Avg 5.01 SD 0.01				
Globular transfer with CO ₂ shielding																
E70S-5 59	32.5	345	317.92	751	0.40	0.34	0.27	9.22	20.28	9.18	20.19	2.63	0.02	<0.01	<0.01	
E70S-5 59	32.5	325	317.92	751	0.40	0.38	0.26	9.22	20.28	9.19	20.22	2.60	0.02	<0.01	<0.01	
E70S-5 59	32.5	330	317.92	751	0.40	0.36	0.26	9.22	20.28	9.19	20.22	2.59	0.02	<0.01	<0.01	
					Avg 0.40 SD 0.00	0.36 0.02	Avg 0.26 SD 0.01			Avg 9.19 SD 0.01	20.21 0.02	Avg 2.61 SD 0.02				
Short circuiting with Ar-25 CO ₂ shielding																
E70S-5 59	19	210	120.65	285	0.25	0.56	0.47	3.50	7.70	3.49	7.59	4.33	0.03	<0.01	<0.01	
E70S-5 59	19	215	120.65	285	0.24	0.52	0.45	3.50	7.70	3.42	7.53	4.23	0.03	<0.01	<0.01	
E70S-5 59	19	210	120.65	285	0.24	0.55	0.45	3.50	7.70	3.42	7.53	4.27	0.03	<0.01	<0.01	
					Avg 0.24 SD 0.01	0.54 0.02	Avg 0.46 SD 0.01			Avg 3.44 SD 0.02	7.55 0.04	Avg 4.28 SD 0.05				

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25.4 mm (1 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas flow rate: 21-24 liters/min (45-50 ft.³/h)

Electrode weight: 7.92 g/in. (0.20 g/in.)

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B20
Fume generation characteristics of 0.89 mm (0.035 in.) diameter stainless steel gas metal arc electrodes

Electrode Code	Voltage, V avg	Current, A avg	Wire feed rate ¹		Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate		Deposition rate		Wgt of fume/ wt. of deposited metal		Wgt of fume/ length of electrode used	
			mm/s	in./min	Measured g/min	Normalized g/min/1/2 x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	lb/h	g/m	g/in.
ER 316 65	31	175	271.78	642	0.05	0.15	0.06	4.70	10.34	4.65	10.24	0.59	10.24	<0.01	<0.01
ER 316 65	32	165	271.78	642	0.04	0.16	0.06	4.70	10.34	4.61	10.17	0.56	10.17	<0.01	<0.01
ER 316 65	32	170	271.78	642	0.04	0.15	0.06	4.70	10.34	4.63	10.18	0.58	10.18	<0.01	<0.01
					Avg 0.04	0.15	Avg 0.06			Avg 4.63	10.20	Avg 0.58			
					SD 0.01	0.01	SD 0.00			SD 0.02	0.04	SD 0.02			

*g/kg + 10 = weight of fume expressed as a percentage of the deposit weight

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25.4 mm (1 in.)

Welding time: 1 minute

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas: Ar-2 O₂

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: Code 65: 4.79 g/m (0.12 g/in.)

Base plate: 304 SS

Metal deposition rate determined for only 1 test per electrode

SD: standard deviation (sigma)

Table B22
Fume generation characteristics of 1.19 mm (3/64 in.) diameter 4043 aluminum gas metal arc electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Contact tube-to-work distance		Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used g/in.
				mm	in.	Measured g/min	Normalized g/min/l ^{1/2} x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		
ER4043	61	23	160	19.1	0.75	0.11	0.43	0.60	1.09	2.40	1.03	2.27	6.33	0.02
	61	22	165	19.1	0.75	0.10	0.37	0.55	1.09	2.40	1.02	2.25	5.88	0.02
ER4043	61	23	165	25.4	1.00	0.28	1.02	1.45	1.15	2.53	1.05	2.30	15.96	0.04
	61	23	160	25.4	1.00	0.27	1.07	1.44	1.15	2.53	1.06	2.33	15.59	0.04
ER4043	61	23	165	25.4	1.00	0.27	1.00	1.43	1.15	2.53	1.05	2.30	15.68	0.04
	61	23	165	25.4	1.00	0.27	1.00	1.43	1.15	2.53	1.05	2.30	15.68	0.04
								Avg 1.44	Avg 1.05		Avg 1.05		Avg 15.74	
								SD 0.01	SD 0.01		SD 0.01		SD 0.19	

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Wire feed rate: 1.04/14 mm/s (246 in./min) for 3/4 in. stickout; 109.64 mm/s (259 in./min) for 1 in. stickout.

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas: argon

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: 2.90 g/m (0.07 g/in.)

Base plate: 1100 Al

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B23
Fume generation characteristics of 1.19 mm (3/64 in.) diameter ER5356 aluminum gas metal arc electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Contact tube-to-work distance		Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h lb/h	Deposition rate kg/h lb/h	Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used g/m g/in.
				mm	in.	Measured g/min	Normalized g/min/l ² x 10 ⁻⁵					
ER5356	60	22	160	12.7	0.50	1.41	5.50	6.26	1.35 2.96	1.30 2.85	65.16	0.18 <0.01
ER5356	60	22	165	12.7	0.50	1.43	5.24	6.34	1.35 2.96	1.31 2.88	65.40	0.18 <0.01
ER5356	60	22	165	12.7	0.50	1.39	5.10	6.16	1.35 2.96	1.31 2.85	64.27	0.18 <0.01
						Avg 1.41 SD 0.02	5.28	6.25	Avg 1.31 SD 0.01	1.286	64.94	
ER5356	60	23.5	165	19.1	0.75	1.75	6.42	6.60	1.59 3.50	1.33 2.93	78.84	0.19 <0.01
ER5356	60	23.5	160	19.1	0.75	1.74	6.79	6.56	1.59 3.50	1.30 2.85	80.59	0.19 <0.01
						Avg 1.75 SD 0.01	6.60	6.58	Avg 1.31 SD 0.02	1.289	79.72	
ER5356	60	23	150	25.4	1.00	3.75	16.62	14.82	1.52 3.34	1.40 2.93	168.24	0.43 0.01
ER5356	60	23	155	25.4	1.00	3.57	14.87	14.15	1.52 3.34	1.25 2.75	171.46	0.41 0.01
ER5356	60	23	155	25.4	1.00	3.47	14.45	13.76	1.52 3.34	1.35 2.96	154.85	0.40 0.01
						Avg 3.59 SD 0.13	15.31	14.24	Avg 1.31 SD 0.05	1.288	164.85	0.41 0.01
							1.15			0.12	8.81	SD 0.02

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Wipe feed rate: 129.54 mm/s (306 in./min) for 1/2 in. stickout; 152.40 mm/s (360 in./min) for 3/4 in. stickout;
145.20 mm/s (343 in./min) for 1 in. stickout.

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas: argon

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: 2.90 g/m (0.07 g/in.)

Base plate: 5083 Al

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B24
Fume generation characteristics of 1.14 mm (0.045 in.) diameter copper-base gas metal arc electrodes

Electrode	Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	Wire feed rate in./min	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h	Deposition rate kg/h	Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used g/in.
						Measured g/min	Normalized g/min/l ² x 10 ⁻⁵					
ERCu	76	27	205	120.66	285	0.31	0.75	0.49	3.83	3.70	8.15	0.04
ERCu	76	27	205	120.66	285	0.29	0.69	0.46	3.83	3.60	7.93	0.04
ERCu	76	27.5	210	120.66	285	0.29	0.67	0.47	3.83	3.62	7.96	0.04
						Avg 0.30 SD 0.01	0.70 0.04	Avg 0.47 SD 0.02	Avg 3.64 SD 0.05	8.01	Avg 4.93 SD 0.13	0.06
ERCuAl-A2	75	27.5	210	129.54	306	0.47	1.08	0.80	3.55	3.50	7.69	0.06
ERCuAl-A2	75	27.5	215	129.54	306	0.47	1.02	0.80	3.55	3.50	7.69	0.06
ERCuAl-A2	75	28	215	129.54	306	0.46	1.00	0.78	3.55	3.40	7.47	0.06
						Avg 0.47 SD 0.01	1.03 0.04	Avg 0.79 SD 0.01	Avg 3.46 SD 0.06	7.62	Avg 8.12 SD 0.04	0.06

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 19.05 mm (0.75 in.)

Welding time: 1/2 minute

Welding speed: Code 75: 6.77 mm/s (16 in./min); Code 76: 5.08 mm/s (12 in./min)

Shielding gas: argon

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: Code 75: 7.59 g/m (0.19 g/in.); Code 76: 8.8 g/m (0.22 g/in.)

Base plate: Copper for ERCu

Aluminum-bronze for ERCu Al-A2

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B25
Fume generation characteristics of 2.38 mm (3/32 in.) diameter E70T-1 flux cored electrodes (75 Ar-25 CO₂) shielding

Code	Voltage, V	Current, A	Wire feed rate		Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Metal deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
			mm/s	in./min	Measured g/min	Normalized g/min/l ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
40	30.5	465	88.90	210	1.01	0.47	0.67	9.08	19.70	7.73	17.18	7.79	0.19	>0.01	>0.01
40	30.5	460	88.90	210	1.01	0.48	0.67	9.08	19.70	7.74	17.21	7.78	0.19	>0.01	>0.01
40	30.5	445	88.90	210	1.01	0.51	0.67	9.08	19.70	7.72	17.15	7.77	0.19	>0.01	>0.01
					Avg 1.01 SD >0.01	0.49 0.02	Avg 0.67 SD >0.01	Avg 7.73 SD 0.01		Avg 7.73 SD 0.03		Avg 7.78 SD 0.01			
42	30.5	445	88.90	210	1.94	0.98	1.29	9.01	19.82	7.73	17.18	14.88	0.36	0.01	0.01
42	30.5	445	88.90	210	1.92	0.97	1.28	9.01	19.82	7.71	17.13	14.82	0.36	0.01	0.01
42	30.5	445	88.90	210	1.93	0.97	1.29	9.01	19.82	7.62	16.94	15.02	0.36	0.01	0.01
					Avg 1.93 SD 0.01	0.97 >0.01	Avg 1.29 SD >0.01	Avg 7.69 SD 0.06		Avg 7.69 SD 0.13		Avg 14.91 SD 0.10			

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 38 mm (1-1/2 in.)

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Welding speed: 6.77 mm/s (1.6 in./min)

Electrode weight/unit length: Code No. 40: 28.35 g/m (0.72 g/in.)

Code No. 42: 27.95 g/m (0.71 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B25a
Comparison of average fume generation characteristics of 2.38 mm (3/32 in.) diameter
E70T-1 electrodes as a function of shielding gas

Code	Shielding gas	Voltage, V	Current, A	Average fume generation rate		Average metal deposition rate kg/h	Average weight of fumes/ weight of deposited metal lb/h	Average weight of fumes/ weight of deposited metal g/kg*
				Measured g/min	Normalized g/min/l ² x 10 ⁻⁵			
40	CO ₂	30.5	475	1.35	0.59	7.73	17.18	10.40
40	Ar-25%CO ₂	30.5	465	1.01	0.49	7.73	17.18	7.78
42	CO ₂	31	440	2.27	1.17	7.71	17.13	17.51
42	Ar-25%CO ₂	30.5	445	1.93	0.97	7.69	17.08	14.91

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Wire feed rate: 87.0-88.9 mm/s

Shielding gas flow rate: 21-24 liters/min

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

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Table B26
Fume generation characteristics of a 3.97 mm (5/32 in.) diameter E7018 electrode as a function of current

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ length of electrode used g/in.
			Measured g/min	Normalized g/min/ $I^2 \times 10^{-5}$		kg/h	lb/h	kg/h	lb/h	
E7018	10	21	0.36	2.16	1.23	1.78	3.91	1.26	2.76	1.84
E7018	10	20	0.40	1.76	1.23	1.93	4.24	1.37	3.01	1.84
E7018	10	21	0.42	1.63	1.20	2.09	4.61	1.45	3.18	1.79
E7018	10	20	0.41	1.42	1.18	2.09	4.60	1.44	3.17	1.75
E7018	10	20.5	0.50	1.45	1.34	2.22	4.89	1.48	3.26	2.01
E7018	10	21.5	0.55	1.60	1.38	2.38	5.23	1.74	3.83	2.05
E7018	10	21	0.60	1.66	1.50	2.40	5.28	1.75	3.85	2.23
E7018	10	22	0.72	1.62	1.69	2.54	5.58	1.75	3.85	2.62
E7018	10	21	0.73	1.66	1.76	2.49	5.47	1.87	4.11	2.63

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: 3.81 mm/s (9 in./min)

Welding time: 1 minute

Electrode weight: 148.42 g/m (3.77 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B27
Fume generation characteristics of a 3.97 mm (5/32 in.) diameter E6010 covered electrode as a function of current

Electrode	Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used $\times 100$	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
				Measured g/min	Normalized $\text{g}/\text{min}/\text{in}^2 \times 10^{-5}$		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E6010	11	25	100	0.36	3.60	1.57	1.40	3.08	1.20	2.63	18.07	1.79	0.05
E6010	11	24	100	0.36	3.60	1.49	1.45	3.20	1.15	2.54	18.71	1.73	0.04
E6010	11	24.5	110	0.36	2.98	1.53	1.41	3.11	1.15	2.52	18.85	1.79	0.05
				Avg 0.36 SD 0.00	3.39	Avg 1.53 SD 0.04	Avg 1.42 SD 0.03	3.13	Avg 1.17 SD 0.03	2.56	Avg 18.54 SD 0.42	Avg 1.75 SD 0.04	0.05
E6010	11	23	130	0.47	2.78	1.67	1.69	3.72	1.38	3.04	20.41	1.94	0.05
E6010	11	22	135	0.49	2.69	1.68	1.75	3.85	1.39	3.05	21.21	1.94	0.05
E6010	11	22.5	125	0.48	3.07	1.66	1.74	3.82	1.39	3.05	20.77	1.98	0.05
				Avg 0.48 SD 0.01	2.85	Avg 1.67 SD 0.01	Avg 1.73 SD 0.03	3.80	Avg 1.39 SD 0.01	3.05	Avg 20.80 SD 0.40	Avg 1.96 SD 0.02	0.05
E6010	11	22.5	140	0.79	4.03	2.62	1.81	3.99	1.39	3.06	34.08	3.03	0.08
E6010	11	23	145	0.78	3.71	2.60	1.80	3.97	1.40	3.07	33.54	3.00	0.08
E6010	11	22	145	0.79	3.76	2.69	1.76	3.88	1.41	3.11	33.53	3.11	0.08
				Avg 0.79 SD 0.01	3.83	Avg 2.64 SD 0.05	Avg 1.79 SD 0.03	3.95	Avg 1.40 SD 0.01	3.08	Avg 33.71 SD 0.32	Avg 3.05 SD 0.04	0.08
E6010	11	23.5	150	0.83	3.69	2.74	1.82	4.00	1.43	3.15	34.78	3.17	0.08
E6010	11	23	150	0.83	3.69	2.70	1.84	4.06	1.42	3.13	35.00	3.13	0.08
E6010	11	23	150	0.83	3.69	2.68	1.86	4.10	1.43	3.15	34.78	3.09	0.08
				Avg 0.83 SD 0.00	3.69	Avg 2.71 SD 0.03	Avg 1.84 SD 0.02	4.05	Avg 1.43 SD 0.01	3.14	Avg 34.85 SD 0.13	Avg 3.13 SD 0.04	0.08
E6010	11	22	170	1.18	4.08	3.45	2.05	4.51	1.50	3.30	47.19	4.00	0.10
E6010	11	22	175	1.17	3.82	3.43	2.05	4.51	1.50	3.30	46.79	3.96	0.10
E6010	11	23	170	1.17	4.05	3.43	2.05	4.51	1.50	3.30	46.79	3.98	0.10
				Avg 1.17 SD 0.01	3.98	Avg 3.44 SD 0.01	Avg 2.05 SD 0.00	4.51	Avg 1.50 SD 0.00	3.30	Avg 46.93 SD 0.23	Avg 3.98 SD 0.02	0.10

*g/kg $\div 10$ = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: 3.39 to 4.87 mm/s (8 to 11.5 in./min)

Welding time: 1 minute

Electrode weight: 114.57 g/m (2.91 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

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Table B28
Fume generation characteristics of 2.38 mm (3/32 in.) diameter E70T-1
flux cored electrode as a function of current and voltage

Electrode	Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	Fume generation rate		Wgt. of fume/ length of electrode used g/m	Wgt. of fume/ length of electrode used g/in.										
					Measured g/min	Normalized g/min/√ $I^2 \times L \times 10^{-5}$												
									Effect of current									
E70T-1	41	28	345	52.49	1.24	0.96	1.24	13.99	10.80	4.91	5.56	12.23	4.91	10.80	13.99	0.37	0.01	
E70T-1	41	27	345	52.49	1.24	1.11	0.93	1.20	13.99	10.80	4.70	5.56	12.23	4.70	10.80	14.21	0.35	0.01
E70T-1	41	22	360	55.88	132	1.06	0.82	1.07	13.26	10.57	4.81	5.95	13.08	4.81	10.57	13.26	0.32	0.01
E70T-1	41	25	350	52.49	124	1.08	0.88	1.16	13.72	10.41	4.73	5.59	12.29	4.73	10.41	13.72	0.34	0.01
E70T-1	41	22	330	52.49	124	1.01	0.93	1.09	12.10	11.05	5.02	5.58	12.27	5.02	11.05	12.10	0.32	0.01
E70T-1	41	29	425	72.39	171	0.97	0.54	0.76	8.58	14.90	6.79	7.70	16.95	6.79	14.90	8.58	0.22	0.01
E70T-1	41	31	475	85.09	201	0.99	0.44	0.66	7.30	18.00	8.18	9.06	19.92	8.18	18.00	7.30	0.19	<0.01
E70T-1	41	31	485	85.09	201	1.01	0.43	0.67	7.21	18.40	8.36	9.06	19.82	8.36	18.40	7.21	0.20	0.01
E70T-1	41	34	525	90.59	214	1.33	0.49	0.83	8.73	20.11	9.14	9.64	21.21	9.14	20.11	8.73	0.24	<0.01
E70T-1	41	35	600	113.45	268	2.04	0.57	1.01	10.74	25.03	11.38	12.06	26.54	11.38	25.03	10.74	0.30	0.01
Effect of voltage																		
E70T-1	41	20	460	79.16	187	0.61	0.29	0.44	4.97	16.28	7.40	8.41	18.51	7.40	16.28	4.97	0.13	<0.01
E70T-1	41	30	450	79.16	187	0.91	0.45	0.65	7.32	16.44	7.47	8.41	18.51	7.47	16.44	7.32	0.19	<0.01
E70T-1	41	36	435	76.20	180	1.21	0.64	0.90	10.49	15.22	6.92	8.11	17.84	6.92	15.22	10.49	0.26	0.01
E70T-1	41	25	555	110.06	260	0.64	0.21	0.33	3.63	23.18	10.54	11.69	25.72	10.54	23.18	3.63	0.10	<0.01
E70T-1	41	34	540	109.22	258	1.46	0.50	1.51	8.20	23.58	10.72	11.62	25.57	10.72	23.58	8.20	0.22	0.01
E70T-1	41	38	540	103.72	245	2.01	0.69	2.19	12.41	21.41	9.73	11.13	24.48	9.73	21.41	12.41	0.32	0.01
E70T-1	41	39	325	46.99	111	1.45	1.37	1.65	21.25	8.98	4.08	5.00	10.99	4.08	8.98	21.25	0.51	0.01
E70T-1	41	39	405	63.08	149	1.42	0.87	1.28	14.48	12.95	5.89	6.68	14.71	5.89	12.95	14.48	0.37	0.01
E70T-1	44	20	310	48.26	114	0.86	0.90	2.10	9.25	9.25	4.21	5.13	11.29	4.21	9.25	12.32	0.30	0.01
E70T-1	41	39	315	46.99	111	1.47	1.49	1.77	21.68	8.98	4.08	5.00	10.99	4.08	8.98	21.68	0.50	0.01

*g/kg × 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Direct current: electrode positive

Electrode contact tube-to-work distance: 31.8 mm (1.25 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas: CO₂Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: (0.75 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B29
Fume generation characteristics of a 1.14 mm (0.045 in.) diameter E70S-3 gas metal arc electrode as a function of current

Electrode	Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	in./min	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
						Measured g/min	Normalized g/min/in. ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/in.	g/m	g/in.
E70S-3	58	35	240	132.50	313	0.25	0.43	0.80	3.77	8.30	3.75	8.25	4.00	0.03	0.03	<0.01
E70S-3	58	35.5	245	132.50	313	0.24	0.40	0.77	3.77	8.30	3.52	7.74	4.14	0.03	0.03	<0.01
E70S-3	58	35	240	132.50	313	0.25	0.44	0.81	3.77	8.30	3.65	8.04	4.17	0.03	0.03	<0.01
E70S-3	58	35	240	132.50	313	0.26	0.45	0.83	3.77	8.30	3.60	7.93	4.32	0.03	0.03	<0.01
						Avg 0.25 SD 0.01	0.43 0.02	Avg 0.80 SD 0.03	Avg 3.63 SD 0.10	Avg 8.25 SD 0.21	Avg 4.15 SD 0.13					
E70S-3	58	34.5	260	162.56	384	0.48	0.71	0.62	4.64	10.20	4.54	9.99	6.32	0.05	0.05	<0.01
E70S-3	58	35	270	162.56	384	0.47	0.64	0.61	4.64	10.20	4.53	9.96	6.21	0.05	0.05	<0.01
E70S-3	58	34.5	270	162.56	384	0.47	0.62	0.60	4.64	10.20	4.54	9.99	6.16	0.05	0.05	<0.01
						Avg 0.47 SD 0.01	0.66 0.05	Avg 0.61 SD 0.01	Avg 4.54 SD 0.01	Avg 9.98 SD 0.02	Avg 6.22 SD 0.08					
E70S-3	58	34	290	173.57	410	0.46	0.54	0.57	4.82	10.61	4.81	10.57	5.70	0.05	0.05	<0.01
E70S-3	58	35	280	173.57	410	0.46	0.59	0.57	4.82	10.61	4.81	10.59	5.67	0.05	0.05	<0.01
E70S-3	58	34	285	173.57	410	0.44	0.54	0.55	4.82	10.61	4.81	10.57	5.48	0.05	0.05	<0.01
						Avg 0.45 SD 0.01	0.56 0.03	Avg 0.56 SD 0.01	Avg 4.81 SD 0.00	Avg 10.58 SD 0.01	Avg 5.61 SD 0.12					
E70S-3	58	35.5	295	189.65	448	0.45	0.51	0.50	5.41	11.90	5.20	11.44	5.12	0.04	0.04	<0.01
E70S-3	58	35	300	189.65	448	0.54	0.60	0.60	5.41	11.90	5.17	11.39	6.25	0.05	0.05	<0.01
E70S-3	58	35	300	189.65	448	0.53	0.59	0.59	5.41	11.90	5.19	11.42	6.13	0.05	0.05	<0.01
						Avg 0.51 SD 0.05	0.57 0.05	Avg 0.56 SD 0.06	Avg 5.19 SD 0.01	Avg 11.42 SD 0.03	Avg 5.85 SD 0.57					

*g/kg x 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 25.4 mm (1 in.)

Welding time: 30 seconds

Welding speed: 6.77 mm/s (16 in./min)

Shielding gas: A-20₂

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Electrode weight: 7.92 g/m (0.20 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B30
Fume generation rate of E6013 electrodes with different diameters (electrode negative)

Electrode	Code	Voltage, V avg	Current, A avg	Electrode diameter mm in.	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h lb/h	Deposition rate kg/h lb/h	Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used g/m g/in.
					Measured g/min	Normalized g/min/l ^{1/2} x 10 ⁻⁵					
E6013	4	25	155	3.18 1/8	0.83	3.47	2.24	2.22 4.90	1.13	44.34	1.68 0.04
E6013	4	26	155	3.18 1/8	0.85	3.53	2.26	2.26 4.98	1.03	49.45	1.70 0.04
E6013	4	24	155	3.18 1/8	0.84	3.50	2.24	2.25 4.96	1.14	44.18	1.69 0.04
					Avg 0.84 SD 0.01	3.50	Avg 2.25 SD 0.01	4.95	Avg 1.10 SD 0.06	Avg 45.98 SD 3.01	Avg 1.69 SD 0.01
E6013	4	21	145	3.97 5/32	0.30	1.42	1.02	1.76 3.87	1.39	12.93	1.20 0.03
E6013	4	22	150	3.97 5/32	0.30	1.32	1.04	1.71 3.77	1.37	12.98	1.22 0.03
E6013	4	22	150	3.97 5/32	0.29	1.30	1.00	1.76 3.87	1.38	12.73	1.21 0.03
					Avg 0.30 SD 0.01	1.35	Avg 1.02 SD 0.02	3.84	Avg 1.38 SD 0.01	Avg 12.88 SD 0.13	Avg 1.21 SD 0.01
E6013	4	19	140	4.76 3/16	0.14	0.74	0.51	1.73 3.79	1.44	5.91	0.81 0.02
E6013	4	19	140	4.76 3/16	0.15	0.77	0.54	1.70 3.75	1.48	6.14	0.88 0.02
E6013	4	18	150	4.76 3/16	0.15	0.69	0.53	1.74 3.83	1.46	6.36	0.88 0.02
					Avg 0.15 SD 0.01	0.73	Avg 0.53 SD 0.02	3.79	Avg 1.46 SD 0.02	Avg 6.14 SD 0.20	Avg 0.86 SD 0.04

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: negative

Welding speed: 1/8 in. diameter electrode: 4.02 mm/s (9.5 in./min);
5/32 in. diameter electrode: 3.55 mm/s (8.38 in./min);
3/16 in. diameter electrode: 2.75 mm/s (6.5 in./min)

Electrode weight: 1/8 in. diameter electrode: 75.13 g/m (1.91 g/in.)
5/32 in. diameter electrode: 117.50 g/m (2.98 g/in.)
3/16 in. diameter electrode: 164.74 g/m (4.18 g/in.)

Code 4: All electrodes made by same manufacturer.

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B31
Fume generation rate of E6013 electrodes with different diameters (electrode positive)

Electrode	Code	Voltage, V avg	Current, A avg	Electrode diameter mm in.	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h lb/h	Deposition rate kg/h lb/h	Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/ft ² x 10 ⁻⁵					g/m	g/in.
E6013	4	25	150	3.18 1/8	1.12	4.99	3.42	1.97 4.34	1.06 2.34	63.45	2.57	0.07
E6013	4	24	155	3.18 1/8	1.16	4.84	3.43	2.04 4.48	1.07 2.36	65.02	2.58	0.07
E6013	4	24	160	3.18 1/8	1.14	4.46	3.38	2.03 4.46	1.06 2.33	64.63	2.54	0.06
					Avg 1.14 SD 0.02	4.76 0.27	Avg 3.41 SD 0.03	Avg 2.01 SD 0.03	Avg 1.06 SD 0.01	Avg 64.37 SD 0.82	Avg 2.56 SD 0.02	0.07
E6013	4	23	145	3.97 5/32	0.45	2.12	1.54	1.73 3.81	1.14 2.51	23.42	1.81	0.05
E6013	4	22	145	3.97 5/32	0.46	2.17	1.58	1.73 3.81	1.15 2.52	23.90	1.86	0.05
E6013	4	21	150	3.97 5/32	0.47	2.08	1.62	1.73 3.80	1.14 2.51	24.62	1.91	0.05
					Avg 0.46 SD 0.01	2.12 0.05	Avg 1.58 SD 0.04	Avg 1.73 SD 0.00	Avg 1.14 SD 0.01	Avg 23.97 SD 0.61	Avg 1.86 SD 0.05	0.05
E6013	4	19	150	4.76 3/16	0.21	0.94	0.70	1.82 4.00	1.51 3.33	8.36	1.15	0.03
E6013	4	19	150	4.76 3/16	0.24	1.06	0.81	1.78 3.93	1.53 3.36	9.44	1.33	0.03
E6013	4	20	150	4.76 3/16	0.24	1.08	0.82	1.78 3.91	1.53 3.36	9.55	1.35	0.03
					Avg 0.23 SD 0.02	1.03 0.07	Avg 0.77 SD 0.07	Avg 1.79 SD 0.02	Avg 1.52 SD 0.01	Avg 9.11 SD 0.66	Avg 1.28 SD 0.11	0.03

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: 3.91 mm/s (9.25 in./min) with 1/8 in. diameter electrode;
3.81 mm/s (9 in./min) with 5/32 in. diameter electrode;
3.12 mm/s (7.38 in./min) with 3/16 in. diameter electrodes

Electrode weight: 1/8 in. diameter electrode: 75.15 g/m (1.91 g/in.)
5/32 in. diameter electrode: 117.50 g/m (2.98 g/in.)
3/16 in. diameter electrode: 164.74 g/m (4.18 g/in.)

Code 4: All electrodes made by same manufacturer.

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

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Table B32
Fume generation characteristics of E7018 covered electrodes with different diameters

Electrode	Code	Voltage, V avg	Current, A avg	Electrode diameter mm in.	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/l ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
E7018	10	21	65	2.38	0.19	4.58	1.30	0.90	1.97	0.59	1.29	19.69	0.77	0.02	0.02
E7018	10	22	63	2.38	0.19	4.87	1.28	0.90	1.97	0.58	1.25	19.61	0.76	0.02	0.02
E7018	10	21	65	2.38	0.19	4.45	1.31	0.86	1.89	0.57	1.25	19.79	0.79	0.02	0.02
					Avg	4.64	Avg	0.88	1.94	Avg	1.28	Avg	19.69	Avg	0.77
					SD	0.21	SD	0.02	0.04	SD	0.01	SD	0.09	SD	0.01
E7018	10	21	100	3.18	0.33	3.34	1.63	1.23	2.71	0.90	1.98	22.26	1.62	0.04	0.04
E7018	10	23	100	3.18	0.32	3.19	1.54	1.24	2.73	0.85	1.88	22.42	1.54	0.04	0.04
E7018	10	22	100	3.18	0.33	3.34	1.62	1.24	2.72	0.91	2.00	22.07	1.62	0.04	0.04
					Avg	3.29	Avg	1.24	2.72	Avg	1.95	Avg	22.25	Avg	1.59
					SD	0.01	SD	0.01	0.01	SD	0.06	SD	0.18	SD	0.04
E7018	10	22	160	3.97	0.50	1.95	1.53	1.96	4.32	1.45	3.20	20.64	2.27	0.06	0.06
E7018	10	22	155	3.97	0.49	2.10	1.52	1.98	4.35	1.49	3.28	20.13	2.25	0.06	0.06
E7018	10	22	155	3.97	0.50	2.06	1.50	1.98	4.35	1.48	3.25	20.07	2.22	0.06	0.06
					Avg	2.03	Avg	1.97	4.34	Avg	3.24	Avg	20.28	Avg	2.25
					SD	0.01	SD	0.01	0.02	SD	0.04	SD	0.31	SD	0.02
E7018	10	22	230	4.76	0.73	1.37	1.53	2.84	6.25	2.16	4.74	20.21	2.97	0.07	0.07
E7018	10	22	230	4.76	0.73	1.34	1.55	2.85	6.28	2.17	4.78	20.36	3.00	0.08	0.08
E7018	10	21	220	4.76	0.72	1.56	1.56	2.79	6.13	2.13	4.68	20.40	2.98	0.08	0.08
					Avg	1.42	Avg	2.83	6.22	Avg	4.74	Avg	20.32	Avg	2.98
					SD	0.01	SD	0.04	0.08	SD	0.05	SD	0.10	SD	0.01

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Direct current: electrode positive

Welding speed: 3/32 in. diam.: 2.54 mm/s (6 in./min);

1/8 in. diam.: 3.07 mm/s (7.25 in./min);

5/32 in. diam.: 3.81 mm/s (9 in./min);

3/16 in. diam.: 3.81 mm/s (9 in./min)

Electrode weight: 3/32 in. diam.: 59.46 g/m (1.5103 g/in.);

1/8 in. diam.: 99.01 g/m (2.5149 g/in.);

5/32 in. diam.: 147.98 g/m (3.7587 g/in.);

3/16 in. diam.: 194.40 g/m (4.9379 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B33
Fume generation characteristics of E6010 covered electrodes with different diameters

Electrode	Code	Voltage, V avg	Current, A avg	Electrode diameter mm in.	Fume generation rate		Wgt. of fume/ wt. of electrode used $\times 10^{-5}$	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized $\text{g/min/in}^2 \times 10^{-5}$		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
E6010	1	24	55	2.38 3/32	0.15	4.83	1.46	0.60	1.32	0.50	1.10	17.57	0.59	0.01	0.01
E6010	1	---	55	2.38 3/32	0.14	4.66	1.41	0.60	1.32	0.47	1.04	17.84	0.58	0.01	0.01
E6010	1	26	55	2.38 3/32	0.15	4.86	1.46	0.60	1.33	0.50	1.10	17.69	0.59	0.01	0.01
					Avg	4.78	Avg	0.60	1.32	Avg	1.08	Avg	17.70	Avg	0.59
					SD	0.01	SD	0.00	>0.01	SD	0.03	SD	0.13	SD	>0.01
E6010	1	29	85	3.18 1/8	0.31	4.24	1.72	1.07	2.36	0.76	1.66	24.28	1.31	0.03	0.03
E6010	1	28	90	3.18 1/8	0.33	4.08	1.80	1.10	2.43	0.77	1.70	25.60	1.41	0.04	0.04
E6010	1	28	90	3.18 1/8	0.35	4.30	1.88	1.12	2.46	0.78	1.72	26.79	1.32	0.03	0.03
					Avg	4.24	Avg	1.10	2.41	Avg	1.70	Avg	25.56	Avg	1.31
					SD	0.02	SD	0.03	0.05	SD	0.03	SD	1.26	SD	>0.01
E6010	1	27	145	3.97 5/32	0.45	2.15	1.60	1.70	3.73	1.29	2.84	20.98	1.72	0.04	0.04
E6010	1	27	145	3.97 5/32	0.46	2.20	1.64	1.70	3.73	1.30	2.85	21.44	1.77	0.04	0.04
E6010	1	26	145	3.97 5/32	0.43	2.06	1.46	1.78	3.92	1.50	3.30	17.32	1.63	0.04	0.04
E6010	1	26	145	3.97 5/32	0.44	2.09	1.54	1.72	3.79	1.52	3.34	17.39	1.66	0.04	0.04
E6010	1	26	145	3.97 5/32	0.44	2.09	1.48	1.79	3.94	1.51	3.32	17.49	1.63	0.04	0.04
					Avg	2.12	Avg	1.74	3.82	Avg	3.13	Avg	18.92	Avg	1.68
					SD	0.01	SD	0.05	0.10	SD	0.26	SD	2.09	SD	>0.01
E6010	1	29	180	4.76 3/16	0.70	2.16	1.73	2.42	5.33	1.92	4.22	21.87	2.72	0.07	0.07
E6010	1	30	190	4.76 3/16	0.72	1.99	1.77	2.44	5.37	1.94	4.27	22.21	2.76	0.07	0.07
E6010	1	29	190	4.76 3/16	0.73	2.02	1.75	2.50	5.30	1.96	4.31	22.37	2.72	0.07	0.07
					Avg	2.06	Avg	2.45	5.40	Avg	4.26	Avg	22.15	Avg	2.73
					SD	0.02	SD	0.02	0.08	SD	0.05	SD	0.25	SD	>0.01

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Direct current: electrode positive

Welding speed: 3/32 in. diam.: 2.65 mm/s (6.25 in./min);

1/8 in. diam.: 3.18 mm/s (7.5 in./min);

5/32 in. diam.: 3.81 mm/s (9 in./min);

3/16 in. diam.: 4.02 mm/s (9.5 in./min)

Electrode weight: 40.36 g/m (1.0252 g/in.);

1/8 in. diam.: 70.37 g/m (1.7875 g/in.);

5/32 in. diam.: 107.73 g/m (2.7363 g/in.);

3/16 in. diam.: 154.48 g/m (3.9237 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B34
Fume generation characteristics of E6013 covered electrodes with different diameters

Electrode	Code	Voltage, V avg	Current, A avg	Electrode diameter mm in.	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate kg/h lb/h	Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/in. ² x 10 ⁻⁵			kg/h lb/h	g/in.		g/m	g/in.
E6013	4	24	50	2.38 3/32	0.13	5.25	1.17	0.67 1.48	0.49	1.08	15.99	0.55	0.01
E6013	4	26	53	2.38 3/32	0.13	4.70	1.17	0.67 1.47	0.47	1.04	16.38	0.52	0.01
					Avg 0.13	4.98	Avg 1.17	Avg 0.67 1.47	Avg 0.48	1.06	Avg 16.19	Avg 0.53	0.01
					SD >0.01	0.39	SD >0.01	SD 0.00 >0.01	SD 0.01	0.03	SD 0.28	SD 0.02	>0.01
E6013	4	24	83	3.18 1/8	0.17	2.53	0.08	0.96 2.11	0.65	1.43	15.93	0.81	0.02
E6013	4	21	83	3.18 1/8	0.18	2.65	1.21	0.90 1.98	0.62	1.36	17.49	0.86	0.02
E6013	4	22	83	3.18 1/8	0.17	2.57	1.08	0.96 2.11	0.67	1.48	15.40	0.81	0.02
					Avg 0.17	2.57	Avg 1.12	Avg 0.94 2.07	Avg 0.65	1.42	Avg 16.27	Avg 0.83	0.02
					SD >0.01	0.07	SD 0.07	SD 0.03 0.08	SD 0.03	0.06	SD 1.09	SD 0.03	>0.01
E6013	4	22	135	3.97 5/32	0.34	1.88	1.32	1.56 3.43	1.09	2.40	18.79	2.51	0.06
E6013	4	25	137	3.97 5/32	0.35	1.87	1.37	1.56 3.44	1.09	2.39	19.56	2.59	0.07
E6013	4	23	150	3.97 5/32	0.36	1.61	1.33	1.64 3.60	1.20	2.64	18.05	2.65	0.07
					Avg 0.35	1.79	Avg 1.34	Avg 1.59 3.49	Avg 1.13	2.48	Avg 18.80	Avg 2.58	0.07
					SD 0.01	0.16	SD 0.02	SD 0.04 0.10	SD 0.06	0.14	SD 0.75	SD 0.07	>0.01
E6013	4	21	205	4.76 3/16	0.41	0.99	1.09	2.29 5.04	1.84	4.04	13.53	1.79	0.04
E6013	4	20	205	4.76 3/16	0.41	0.98	1.06	2.35 5.18	1.86	4.10	13.34	1.69	0.04
E6013	4	20	200	4.76 3/16	0.42	1.04	1.07	2.40 5.29	1.78	3.91	14.11	1.79	0.04
					Avg 0.41	1.01	Avg 1.07	Avg 2.35 5.17	Avg 1.83	4.02	Avg 13.66	Avg 1.76	0.04
					SD >0.01	0.03	SD 0.02	SD 0.06 0.12	SD 0.04	0.10	SD 0.40	SD 0.06	>0.01

*g/kg + 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Direct current: electrode positive

Welding speed: 3/32 in. diam.: 2.54 mm/s (6 in./min);
1/8 in. diam.: 2.96 mm/s (7 in./min);
5/32 in. diam.: 3.81 mm/s (9 in./min);
3/16 in. diam.: 3.81 mm/s (9 in./min)

Electrode weight: 3/32 in. diam.: 44.04 g/m (1.186 g/in.);
1/8 in. diam.: 75.15 g/m (1.9088 g/in.);
5/32 in. diam.: 117.50 g/m (2.98 g/in.);
3/16 in. diam.: 164.74 g/m (4.18 g/in.)

Metal deposition rate determined for only 1 test per electrode.
SD: standard deviation (sigma).

Table B35
Fume generation characteristics of a 3.97 mm (5/32 in.) diameter E6010 covered electrode as a function of voltage

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ electrode used		Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
			Measured g/min	Normalized g/min/in. ² x 10 ⁻⁵			kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
E6010	11	21	0.78	3.98	2.53	1.85	4.08	1.43	3.14	3.14	32.78	2.91	0.07	0.07
E6010	11	20.5	0.78	3.98	2.52	1.86	4.09	1.42	3.12	3.12	33.42	2.98	0.08	0.08
E6010	11	20.5	0.79	4.02	2.75	1.72	3.79	1.40	3.09	3.09	33.75	3.11	0.08	0.08
			Avg	3.99	Avg	1.81	4.00	Avg	3.12	3.12	33.31	Avg	3.00	0.08
			SD	0.02	SD	0.08	0.17	SD	0.03	0.03	0.49	SD	0.10	0.01
E6010	11	23.5	0.83	3.69	2.74	1.82	4.00	1.43	3.15	3.15	34.78	3.17	0.08	0.08
E6010	11	23	0.83	3.69	2.70	1.84	4.06	1.42	3.13	3.13	35.00	3.13	0.08	0.08
E6010	11	23	0.83	3.69	2.68	1.84	4.10	1.43	3.15	3.15	34.78	3.09	0.08	0.08
			Avg	3.69	Avg	1.83	4.05	Avg	3.14	3.14	34.88	Avg	3.13	0.08
			SD	0.00	SD	0.01	0.05	SD	0.01	0.01	0.13	SD	0.04	0.00
E6010	11	27	1.20	4.97	3.65	1.96	4.32	---	---	---	---	4.17	0.11	0.11
E6010	11	27	1.20	4.70	3.68	1.96	4.32	---	---	---	---	4.17	0.11	0.11
E6010	11	28	1.20	4.68	3.67	1.96	4.32	---	---	---	---	4.17	0.11	0.11
E6010	11	28	1.20	4.99	3.79	1.90	4.18	1.32	2.91	2.91	54.36	---	---	---
			Avg	4.84	Avg	1.95	4.29	---	---	---	---	---	---	---
			SD	0.17	SD	0.03	0.07	---	---	---	---	---	---	---
E6010	11	38.5	1.53	7.28	5.38	1.71	3.76	1.40	3.09	3.09	65.36	6.22	0.16	0.16
E6010	11	37.5	1.64	7.29	5.49	1.79	3.95	1.43	3.15	3.15	68.72	6.34	0.16	0.16
E6010	11	37.5	1.56	6.93	5.36	1.75	3.85	1.40	3.09	3.09	66.64	6.22	0.16	0.16
			Avg	7.17	Avg	1.75	3.85	Avg	3.11	3.11	66.91	Avg	6.26	0.16
			SD	0.02	SD	0.04	0.10	SD	0.03	0.03	1.70	SD	0.07	0.00

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Welding time: 1 minute

Notes:

Electrode weight: 114.57 g/m (2.91 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Electrode polarity: positive

Welding speed: 3.39 to 4.45 mm/s (8 to 10.5 in./min)

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Table B36
Fume generation rates of 3.97 mm (5/32 in.) diameter E6010, E6013, and E7018 electrodes as a function of arc length

Electrode	Code	Arc length		Voltage, V	Current, A	Fume generation rate, g/m	
		mm	in.			Measured	Normalized*
E6010	1	0	0	23	140	0.53	0.61
E6010	1	0	0	24	140	0.47	0.54
E6010	1	1.59	1/16	29	135	0.68	0.84
E6010	1	3.18	1/8	33	140	0.77	0.88
E6010	1	4.76	3/16	35	140	0.68	0.78
E6010	1	6.35	1/4	41	150	0.98	0.98
E6010	1	6.35	1/4	43	150	1.08	1.08
E6013	3	0	0	23	140	0.49	0.56
E6013	3	1.59	1/16	26	150	0.63	0.63
E6013	3	3.18	1/8	29	140	0.53	0.62
E6013	3	4.76	3/16	32	135	0.67	0.83
E6013	3	6.35	1/4	42	165	1.35	1.12
E6013	3	6.35	1/4	43	155	1.19	1.11
E6013	3	7.94	5/16	43	155	1.08	1.07
E6013	3	15.88	5/8	50	135	1.12	1.39
E7018	10	3.18	1/8	23.5	145	0.47	0.51
E7018	10	6.35	1/4	26	145	0.46	0.50
E7018	10	7.94	5/16	31	130	0.45	0.60
E7018	10	9.53	3/8	33	140	0.57	0.65
E7018	10	11.11	7/16	43	150	0.75	0.75

*All fume generation rates normalized to current of 150 amperes.

Notes:

Electrode polarity: positive

Welding time: 30 seconds (nominal).

Table B37
Fume generation characteristics of some 3.97 mm (5/32 in.) diameter high titania
mild steel covered electrodes with iron powder additions

Electrode Code	Voltage, V		Current, A	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Weight of fume/ length of electrode used	
	avg	Code		Measured g/min	Normalized g/min/l ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	
E6013	34	25	165	0.74	2.70	2.03	2.17	4.78	1.47	3.24	30.00	3.24	2.27	0.06
E6013	34	24	165	0.73	2.67	2.00	2.18	4.80	1.46	3.21	29.88	3.21	2.25	0.06
E6013	34	24	170	0.72	2.51	2.00	2.18	4.79	1.46	3.22	29.69	3.22	2.25	0.06
				Avg 0.73	2.63	Avg 2.01	Avg 2.18	4.79	Avg 1.46	3.22	Avg 29.86	Avg 3.22	2.26	0.06
				SD 0.01	0.01	SD 0.02	SD 0.01	0.01	SD 0.01	0.02	SD 0.15	SD 0.01	0.01	0.00
E7014	30	30	175	0.72	2.34	1.63	2.65	5.83	1.83	4.03	23.53	4.03	2.42	0.06
E7014	30	29	175	0.72	2.35	1.62	2.67	5.87	1.81	3.99	23.86	3.99	2.43	0.06
E7014	30	29	175	0.72	2.35	1.63	2.66	5.85	1.81	3.99	23.81	3.99	2.41	0.06
				Avg 0.72	2.35	Avg 1.63	Avg 2.66	5.85	Avg 1.82	4.00	Avg 23.72	Avg 4.00	2.42	0.06
				SD >0.01	>0.01	SD >0.01	SD 0.01	0.02	SD 0.01	0.02	SD 0.18	SD 0.01	0.01	0.00
E7024	35	41	210	0.69	1.56	0.82	5.01	11.03	3.35	7.37	12.34	7.37	2.13	0.05
E7024	35	41	210	0.68	1.54	0.81	5.01	11.02	3.41	7.50	11.93	7.50	2.10	0.05
E7024	35	41	210	0.68	1.55	0.82	5.01	11.02	3.38	7.44	12.12	7.44	2.11	0.05
				Avg 0.68	1.54	Avg 0.82	Avg 5.01	11.02	Avg 3.38	7.44	Avg 12.13	Avg 7.44	2.11	0.05
				SD 0.01	0.01	SD 0.01	SD 0.00	0.01	SD 0.03	0.06	SD 0.22	SD 0.02	0.02	0.00

*g/kg ÷ 10 = weight of fume expressed as percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: Code 30 and 34 electrodes: 4.23 mm/s (10 in./min); Code 35* electrode: 4.45 mm/s (10.5 in./min).

Electrode weight:

Code 30 electrode: 147.64 g/m (3.75 g/in.)

Code 34 electrode: 115.75 g/m (2.94 g/in.)

Code 35 electrode: 146.85 g/m (3.73 g/in.)

*Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B38
Fume generation characteristics of some 3.97 mm (5/32 in.) diameter low hydrogen
mild steel covered electrodes with iron powder additions

Electrode	Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Weight of fume/ length of electrode used	
				Measured g/min	Normalized g/min/l ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
E7016	29	23	170	0.48	1.67	1.37	2.12	4.66	1.40	3.07	20.78	1.80	0.05
E7016	29	23	175	0.51	1.67	1.44	2.14	4.71	1.48	3.26	20.77	1.79	0.05
E7016	29	23	170	0.49	1.70	1.38	2.14	4.70	1.40	3.09	20.99	1.81	0.05
				Avg	1.68	Avg	2.13	4.69	Avg	3.14	Avg	1.80	0.05
				SD	0.01	SD	0.01	0.03	SD	0.10	SD	0.01	0.00
E7018	36	24	175	0.51	1.66	1.33	2.30	5.06	1.68	3.70	18.16	1.98	0.05
E7018	36	24	180	0.51	1.59	1.36	2.27	5.00	1.65	3.63	18.69	2.02	0.05
E7018	36	24	175	0.51	1.68	1.36	2.28	5.01	1.68	3.70	18.33	2.02	0.05
				Avg	1.64	Avg	2.28	5.02	Avg	3.68	Avg	2.00	0.05
				SD	0.05	SD	0.01	0.03	SD	0.04	SD	0.02	0.00
E7028	32	33	235	1.04	1.89	1.48	4.24	9.34	2.96	6.52	21.11	3.53	0.09
E7028	32	32	235	1.01	1.82	1.43	4.23	9.30	2.88	6.34	20.96	3.45	0.09
E7028	32	34	225	1.03	2.03	1.46	4.24	9.32	2.85	6.26	21.71	3.52	0.09
				Avg	1.91	Avg	4.24	9.32	Avg	6.37	Avg	3.50	0.09
				SD	0.02	SD	0.01	0.02	SD	0.13	SD	0.04	0.00

*g/kg ÷ 10 = weight of fume expressed as percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: Code 32 and 36 electrodes: 4.23 mm/s (10 in./min); Code 29 electrode:
3.81 mm/s (9 in./min).

Electrode weight:

Code 29 electrode: 130.71 g/m (3.32 g/in.)

Code 32 electrode: 196.46 g/m (4.99 g/in.)

Code 36 electrode: 146.85 g/m (3.73 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B39
Fume generation characteristics of 3.97 mm (5/32 in.) diameter E6010, E6013, and E7018 covered electrodes as a function of electrode angle

Electrode Code	Voltage, V avg	Current, A avg	Electrode angle, °	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ deposited metal		Weight of fume/ length of electrode used	
				Measured g/min	Normalized g/min/ft ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
E6010	1	25.5	150	0.79	3.51	2.46	1.92	4.23	1.45	3.20	32.59	2.73	0.07	0.07
E6010	1	27	155	0.95	3.95	3.13	1.83	4.02	1.33	2.93	42.80	3.45	0.09	0.09
E6010	1	27.5	155	1.02	4.24	2.97	2.19	4.82	1.59	3.49	38.58	3.30	0.08	0.08
E6010	1	29	165	1.16	4.26	3.80	1.85	4.06	1.19	2.62	58.44	4.38	0.11	0.11
E6010	1	29	150	1.25	5.55	4.13	1.75	3.86	1.19	2.61	63.22	5.07	0.13	0.13
E6010	1	28	150	1.36	6.04	4.48	1.82	4.00	1.22	2.69	66.74	4.87	0.12	0.12
E6013	3	25	150	0.41	1.82	2.14	2.30	5.06	1.46	3.21	16.84	2.36	0.06	0.06
E6013	3	25	145	0.47	2.19	2.70	2.08	4.59	1.34	2.95	21.01	3.29	0.08	0.08
E6013	3	26	145	0.55	2.44	3.17	2.08	4.59	1.29	2.83	25.67	3.94	0.10	0.10
E7018	10	23	165	0.45	1.65	1.14	1.92	4.21	1.44	3.17	18.74	4.17	0.11	0.11
E7018	10	25	165	0.58	2.13	1.91	1.82	4.00	1.23	2.70	28.35	5.53	0.14	0.14
E7018	10	23.5	170	0.68	2.35	2.15	1.90	4.18	1.22	2.69	33.37	5.65	0.15	0.15

*g/kg ÷ 10 = weight of fume expressed as percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding speed: 3.39 to 4.23 mm/s (8 to 10 in./min).

Electrode weight:

Code 1: 111.02 g/m (2.82 g/in.)

Code 3: 122.05 g/m (3.10 g/in.)

Code 10: 148.42 g/m (3.77 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

202/FUMES AND GASES

Table B40
Fume generation characteristics of 6.35 mm (1/4 in.) diameter E7018 and E7028
covered electrodes at high current levels

Electrode Code	Voltage, V avg	Current, A avg	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Weight of fume/ length of electrode used	
			Measured g/min	Normalized g/min/1/2 x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/in.	g/in.	g/in.
E7018	24	395	1.59	1.02	2.16	4.42	9.71	3.46	7.61	27.57	6.96	0.18	0.18
E7018	24.5	390	1.61	1.06	1.94	4.97	10.94	3.45	7.59	28.00	7.00	0.18	0.18
E7018	22.5	400	1.60	1.00	1.93	4.97	10.93	3.41	7.51	28.15	7.00	0.18	0.18
			Avg 1.60 SD 0.01	1.03	Avg 2.01 SD 0.13	4.78 0.32	10.52 0.71	Avg 3.44 SD 0.02	7.50 0.05	Avg 27.91 SD 0.30	6.99 0.01	0.18	0.00
E7024	44	385	2.10	1.41	1.35	9.36	20.60	6.62	14.56	19.04	6.89	0.17	0.17
E7024	43	390	2.14	1.41	1.37	9.40	20.69	6.63	14.59	19.36	7.02	0.18	0.18
E7024	42.5	395	2.15	1.38	1.37	9.41	20.70	6.63	14.59	19.44	7.05	0.18	0.18
			Avg 2.13 SD 0.02	1.40	Avg 1.36 SD 0.02	9.39 0.03	20.66 0.06	Avg 6.63 SD 0.01	14.58 0.02	Avg 19.28 SD 0.02	6.99 0.04	0.18	0.01

*g/kg ÷ 10 = weight of fume expressed as percentage of the deposit weight.

Notes:

Direct current: electrode positive

Welding speed: Code 72 electrode: 4.23 mm/s (10 in./min); Code 73 electrode: 5.08 mm/s (12 in./min).

Electrode weight:

Code 72 electrode: 357.87 g/m (9.09 g/in.)

Code 73 electrode: 514.46 g/m (13.07 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B41
Comparison of fume generation characteristics of 1.59 mm (1/16 in.) diameter and 2.39 mm (3/32 in.) diameter E70T-1 flux cored electrode (CO₂ shielding)

Code	Voltage, V avg	Current, A avg	Wire feed rate mm/s	Wire feed rate in./min	Fume generation rate		Wgt. of fume/ electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/in. ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h		g/m	g/in.
40	30	485	87.63	207	1.36	0.58	0.91	8.95	19.70	7.72	17.19	10.44	0.26	0.01
40	31	485	87.63	207	1.34	0.57	0.90	8.95	19.70	7.70	17.10	10.37	0.26	0.01
40	31	470	87.63	207	1.36	0.61	0.91	8.95	19.70	7.77	17.27	10.58	0.26	0.01
					Avg 1.36 SD 0.01	0.59 0.02	Avg 0.91 SD 0.01	Avg 7.73 SD 0.04		Avg 7.73 SD 0.04	17.17	Avg 10.40 SD 0.04		
45	34	335	139.07	328.5	1.01	0.90	0.87	6.99	15.39	6.27	13.93	9.57	0.12	>0.01
45	35	325	139.07	328.5	1.01	0.96	0.87	6.99	15.39	6.33	14.06	9.53	0.12	>0.01
45	34	335	139.07	328.5	1.01	0.90	0.87	6.99	15.39	6.29	13.98	9.58	0.12	>0.01
					Avg 1.01 SD 0.00	0.92	Avg 0.87 SD >0.01	Avg 6.30 SD 0.03		Avg 6.30 SD 0.03	13.98	Avg 9.56 SD 0.02		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Electrode contact tube-to-work distance: 31.8 mm (1-1/4 in.)

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h)

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: Code No. 45: 13.78 (0.35 g/in.)
 Code No. 40: 28.35 (0.72 g/in.)

Electrode diameter: Code No. 45: 1.59 mm (1/16 in.)
 Code No. 40: 2.38 mm (3/32 in.)

Metal deposition rate determined for only 1 test per electrode.
 SD: standard deviation (sigma).

Table B42
Fume generation characteristics of E70T-1 flux cored electrodes as a function of
contact tube-to-work distance when operating at 450 amperes

Code	Voltage, V avg	Current, A avg	Contact tube-to- work distance mm	Contact tube-to- work distance in.	Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate kg/h	lb/h	Deposition rate		Wgt. of fume/ wt. of deposited metal g/kg*	Wgt. of fume/ length of electrode used	
					Measured g/min	Normalized g/min/ft ² x 10 ⁻⁵							g/m	g/in.
41	30	450	19.1	0.75	0.92	0.46	0.80	6.89	15.16	6.12	13.59	8.97	0.24	<0.01
41	31	455	19.1	0.75	0.92	0.45	0.81	6.89	15.16	6.07	13.48	9.05	0.24	<0.01
41	29	455	19.1	0.75	0.91	0.44	0.80	6.89	15.16	6.07	13.48	8.96	0.24	<0.01
					Avg 0.92 SD 0.01	0.45 0.01	Avg 0.80 SD 0.01	Avg 6.09 SD 0.03				Avg 8.99 SD 0.05		
41	31	450	25.4	1.00	1.04	0.52	0.76	8.17	17.98	7.30	16.23	8.42	0.22	<0.01
41	30	450	25.4	1.00	1.02	0.50	0.75	8.17	17.98	7.12	15.83	8.52	0.22	<0.01
41	29	445	25.4	1.00	1.02	0.51	0.75	8.17	17.98	7.31	16.25	8.27	0.22	<0.01
					Avg 1.03 SD 0.01	0.51 0.01	Avg 0.75 SD 0.01	Avg 7.24 SD 0.10				Avg 8.40 SD 0.13		
41	30	450	31.8	1.25	0.94	0.46	0.63	8.92	19.62	7.20	15.99	7.76	0.19	<0.01
41	31	450	31.8	1.25	0.95	0.47	0.64	8.92	19.62	7.32	16.26	7.72	0.19	<0.01
41	30	440	31.8	1.25	0.95	0.49	0.64	8.92	19.62	7.34	16.31	7.75	0.19	<0.01
					Avg 0.95 SD 0.01	0.47 0.02	Avg 0.64 SD 0.01	Avg 7.29 SD 0.08				Avg 7.74 SD 0.02		
41	30	450	38.1	1.50	1.03	0.51	0.64	9.19	20.21	8.28	18.40	7.38	0.20	<0.01
41	31	450	38.1	1.50	1.03	0.51	0.68	9.19	20.21	8.27	18.37	7.41	0.20	<0.01
41	30	450	38.1	1.50	1.03	0.51	0.68	9.19	20.21	8.28	18.40	7.42	0.20	<0.01
					Avg 1.03 SD 0.00	0.51 0.00	Avg 0.67 SD 0.01	Avg 8.28 SD 0.01				Avg 7.40 SD 0.02		

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h) CO₂

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: 29.53 g/m (0.75 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).

Table B43
Fume generation characteristics of E70T-1 flux cored electrodes as a function of
contact tube-to-work distance when operating at 520 amperes

Code	Voltage, V avg	Current, A avg	Contact tube-to- work distance		Fume generation rate		Wgt. of fume/ wt. of electrode used x 100	Melting rate		Deposition rate		Wgt. of fume/ wt. of deposited metal		Wgt. of fume/ length of electrode used	
			mm	in.	Measured g/min	Normalized g/min/in. ² x 10 ⁻⁵		kg/h	lb/h	kg/h	lb/h	g/kg*	g/m	g/in.	g/in.
41	30	515	19.1	0.75	1.31	0.49	0.96	8.17	17.98	7.84	17.42	9.92	0.28	<0.01	
41	29	520	19.1	0.75	1.32	0.49	0.97	8.17	17.98	7.86	17.47	9.95	0.28	<0.01	
41	29	510	19.1	0.75	1.31	0.50	0.96	8.17	17.98	7.84	17.42	9.93	0.28	<0.01	
					Avg	0.49	Avg	Avg		Avg		Avg			
					SD	0.01	SD	SD		SD		SD			
41	28	515	25.4	1.00	1.32	0.49	0.79	10.00	21.99	8.95	19.88	8.75	0.23	<0.01	
41	29	520	25.4	1.00	1.32	0.50	0.79	10.00	21.99	8.98	19.96	8.73	0.23	<0.01	
42	29	525	25.4	1.00	1.32	0.49	0.80	10.00	21.99	8.92	19.82	8.82	0.23	<0.01	
					Avg	0.49	Avg	Avg		Avg		Avg			
					SD	0.00	SD	SD		SD		SD			
41	29	510	31.8	1.25	1.33	0.51	0.77	10.38	22.84	9.43	20.96	8.35	0.23	<0.01	
41	31	520	31.8	1.25	1.33	0.49	0.77	10.38	22.84	9.45	20.99	8.42	0.23	<0.01	
41	30	525	31.8	1.25	1.32	0.48	0.77	10.38	22.84	9.35	20.78	8.40	0.22	<0.01	
					Avg	0.49	Avg	Avg		Avg		Avg			
					SD	0.01	SD	SD		SD		SD			
41	29	510	38.1	1.50	1.34	0.52	0.77	10.56	23.23	9.77	21.70	8.17	0.22	<0.01	
41	29	525	38.1	1.50	1.34	0.49	0.76	10.56	23.23	9.88	21.96	8.05	0.22	<0.01	
41	28	525	38.1	1.50	1.33	0.49	0.76	10.56	23.23	9.79	21.75	8.12	0.22	<0.01	
					Avg	0.50	Avg	Avg		Avg		Avg			
					SD	0.01	SD	SD		SD		SD			

*g/kg ÷ 10 = weight of fume expressed as a percentage of the deposit weight.

Notes:

Electrode polarity: positive

Welding time: 30 seconds

Shielding gas flow rate: 21-24 liters/min (45-50 ft³/h) CO₂

Welding speed: 6.77 mm/s (16 in./min)

Electrode weight/unit length: 29.53 g/m (0.75 g/in.)

Metal deposition rate determined for only 1 test per electrode.

SD: standard deviation (sigma).