

All Welding Rods

(H)

**MCKAY**

WELDING PRODUCTS

Welding Rods

Date: August, 1991



**MATERIAL SAFETY DATA SHEET**

**For Manufactured Welding Consumables and Related Products**

Prepared to meet the requirements of OSHA's Hazard Communication Standard, 29 CFR 1910.1200 and the Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499.

MSDS data sheets supplemental to this data sheet are available for all nonstandard and experimental products.

Please also obtain, read, and understand our latest SAFETY AND HEALTH BULLETIN. Available from Teledyne McKay or your local distributor.

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Section 1 — MANUFACTURER/SUPPLIER

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Section 2 — PRODUCT IDENTIFICATION AND INGREDIENTS (INCLUDING HAZARDOUS INGREDIENTS)

This section covers the materials from which these products are manufactured and their weld deposit compositions. When the product is consumed, the fume and gas decomposition products produced are different in percent and form from the ingredients in this section.

The ingredient or ingredients in the product which form the potentially most hazardous decomposition product are marked in these tables with an asterisk (\*). We recommend monitoring for these. See Sections 5 and 6 and McKay's SAFETY AND HEALTH BULLETIN for more details.

For explanation of ingredients marked with the symbol † in these tables, see Section 9 - Section 313 Supplier Notification.

**Table 1—McKAY MILD STEEL COVERED ELECTRODES  
To AWS A5.1, Specification for Carbon Steel Covered Arc Welding Electrodes**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %				OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Iron Fe	
E6010	E6010	.10	.30	.25	Balance	Oxides of Aluminum (Al), Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), and Titanium (Ti), in Various Compounds
E6011	E6011	.08	.35	.25	Balance	
E6012	E6012	.09	.50	.25	Balance	
E6013	E6013	.09	.50	.25	Balance	
E7014	E7014	.08	.70	.45	Balance	
E7024	E7024	.07	.90	.45	Balance	

**Table 2—McKAY MILD STEEL SOLID WELDING WIRES  
To AWS A5.18, Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding with CO<sub>2</sub>, Argon-CO<sub>2</sub> mixes, or Argon-Oxygen mixes**

McKAY GRADE	AWS CLASS	TYPICAL WIRE CHEMISTRY, %					OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Copper Cu †	Iron Fe	
S-3	ER70S-3	.09	1.10	.6	.3*	Balance	None
S-6	ER70S-6	.08	1.50	.9	.3*	Balance	

\*We recommend air monitoring. See Sections 5 and 6 and the labels on the product containers.

**Table 3—McKAY MILD STEEL LOW HYDROGEN COVERED ELECTRODES  
To AWS A5.1, Specification for Carbon Steel Covered Arc Welding Electrodes**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %				OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Iron Fe	
E7016	E7016	.08	.80	.30	Balance	Same as Table 1 plus Fluorides (CaF <sub>2</sub> or others)
E7018M	E7018	.07	1.05	.45	Balance	
E7018 XLM	E7018	.08	1.10	.50	Balance	
E7018-XLM	E7018	.07	1.35	.50	Balance	

**Table 4—McKAY SPEED-ALLOY MILD STEEL FLUX CORED GAS SHIELDED WELDING WIRES  
To AWS A5.5, Specification for Carbon Steel Electrodes for Flux-Cored Arc Welding. V Types for flat, horizontal and vertical with CO<sub>2</sub> or 75/25 Argon-CO<sub>2</sub> shielding. Other Types for flat or horizontal with CO<sub>2</sub> shielding**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH CO <sub>2</sub> , %				OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Iron Fe	
66 (1)	EG 72T-2	.08	1.50	.35	Balance	Most of the following: Oxides of Aluminum (Al), Calcium (Ca), Potassium (K), Sodium (Na), Titanium (Ti), and Fluorides (CaF <sub>2</sub> or others).
71	E70T-1	.08	1.35	.50	Balance	
71-V	E71T-1	.07	1.35*	.45	Balance	
74	E70T-4	.08	.90	.60	Balance	
75	E70T-5	.08	1.25	.50	Balance	
77	E70T-G	.07	1.40*	.40	Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

(1) To AWS A5.28, Consumables used for ElectroGas Welding.

**Table 5—McKAY LOW ALLOY LOW HYDROGEN COVERED ELECTRODES  
To AWS A5.5, Specification for Low Alloy Steel Covered Arc Welding Electrodes**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %								OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Copper Cu †	Iron Fe	
E7018-A1 XLM	E7018-A1	.06	.80	.45					Balance	Oxides of Aluminum (Al), Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), Strontium (Sr), Titanium (Ti), and Calcium Fluoride (CaF <sub>2</sub> )
E7018-C2L XLM	E7018-C2L	.04	.85	.40		3.50			Balance	
7018-HC	None	.21	1.00	.60					Balance	
E8018-G XLM	E8018-G	.08	1.30	.45			.20		Balance	
E8018-W XLM	E8018-W	.07	.80	.45	.60	.50		.50	Balance	
E8018-B2 XLM	E8018-B2	.09	.80	.50	1.20		.55		Balance	
E8018-B2L XLM	E8018-B2L	.04	.80	.35	1.25		.50		Balance	
E8018-C3 XLM	E8018-C3	.05	.90	.45		.95			Balance	
E8018-C1 XLM	E8018-C1	.06	.90	.45		2.30			Balance	
E8018-C2 XLM	E8018-C2	.06	.85	.40		3.30			Balance	
E9018-M XLM	E9018-M	.08	1.00	.40		1.60	.20		Balance	
E9018-B3 XLM	E9018-B3	.07	.80	.35	2.25*		1.05		Balance	
E9018-B3L XLM	E9018-B3L	.04	.80	.35	2.25*		1.05		Balance	
E9018-G XLM	E9018-G	.07	1.50	.45			.55		Balance	
E10018-M XLM	E10018-M	.08	1.25	.40	.10	1.55	.30		Balance	
E10018-D2 XLM	E10018-D2	.11	1.85	.45		.75	.35		Balance	
E11018-M XLM	E11018-M	.07	1.50	.40		1.60	.40		Balance	
E12018-M XLM	E12018-M	.07	1.50	.40	.45	2.00	.40		Balance	
E502-18**	E502-18	.06	.80	.40	5.00*		.50		Balance	
E505-18**	E505-18	.06	.80	.45	9.25*		1.00		Balance	

\*We recommend air monitoring for these. See Sections 5 and 8 and the labels on the product containers.

\*\*These grades are now in AWS A5.4 but will be removed from there and put in AWS A5.5 as E502-18 and E505-18 respectively.

**Table 6—McKAY SPEED-ALLOY LOW ALLOY FLUX CORED GAS SHIELDED WELDING WIRES**  
 To AWS A5.29, Specification for Low Alloy Steel Electrodes for Flux-Cored Arc Welding. V Types for flat, horizontal and vertical with CO<sub>2</sub> or 75/25 Argon/CO<sub>2</sub> shielding. Other Types for flat and horizontal with CO<sub>2</sub> shielding

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH CO <sub>2</sub> , %								OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Copper Cu †	Iron Fe	
70-A1	E70T5-A1	.08	.85	.50			.55		Balance	Most of the following: Oxides of Aluminum (Al), Calcium (Ca), Potassium (K), Sodium (Na), Titanium (Ti), and Fluorides (CaF <sub>2</sub> or others).
71-A1	E80T1-A1	.08	.90	.55			.55		Balance	
71A1-V	E81T1-A1	.06	1.10*	.65			.50		Balance	
75-A1	E70T5-A1	.08	.85	.50			.55		Balance	
81B2-L	E80T1-B2	.04	.80	.55	1.15		.50		Balance	
81B2L-V	E81T1-B2	.03	.85*	.55	1.15		.50		Balance	
81N11-V	E81T1-N11	.05	1.20*	.30		.95			Balance	
81N12-V	E81T1-Ni2	.06	1.00*	.35		2.00			Balance	
81-W	E80T1-W	.07	1.05	.55	.55	.60		.50	Balance	
81W-V	E80T1-W	.05	1.20*	.50	.60	.70		.60	Balance	
85	E80T5-K2	.08	1.00	.55		1.30		.15	Balance	
85-B2	E80T5-B2	.08	.80	.55	1.40		.55		Balance	
85-B2L	E80T5-B2L	.04	.80	.55	1.40		.55		Balance	
85-C1	E80T5-Ni2	.08	.96	.55		2.50			Balance	
85-C2	E90T5-Ni3	.06	1.00	.55		3.30			Balance	
85-C3	E80T5-K1	.05	.95	.55		.95	.55		Balance	
86 (1)	EG80T-G	.06	1.30	.30		1.70	.20		Balance	
86-B2 (1)	EG80T-G	.07	.80	.40	1.20		.55		Balance	
87-W (2)	E80C-G	.07	1.00	.45	.55	.85		.60	Balance	
81	E90T1-K2	.08	1.30	.55		1.50		.15	Balance	
91B3-L	E90T1-B3L	.03	.80	.55	2.40		1.05		Balance	
91B3L-V	E91T1-B3	.04	.90*	.50	2.15		1.05		Balance	
91B3-V	E91T1-B3	.09	1.10*	.60	2.20		1.05		Balance	
95	E90T5-K2	.08	1.25	.50		1.60	.20		Balance	
95-D2	E90T5-D2	.07	1.85	.50			.45		Balance	
105	E100T5-K3	.08	1.35	.55		2.00	.30		Balance	
105-D2	E100T5-D2	.09	1.90	.55			.40		Balance	
107 (2)	E100C-G	.05	1.20	.30		1.80	.30		Balance	
111	E110T1-K3	.06	1.45	.60		2.10	.35		Balance	
111-V	E110T1-K3	.05	1.70*	.40		2.00	.40		Balance	
115	E110T5-K3	.06	1.50	.55		2.20	.30		Balance	
117 (2)	E110C-G	.06	1.30*	.30		2.20	.35		Balance	
121-H	E120T1-K5	.18	1.40	.55	.45	1.25	.30		Balance	
125	E120T5-K4	.06	1.40	.55	.40	2.20	.35		Balance	
4130-V	E121T1-G	.19	1.20*	.80	1.10		.35		Balance	
5025 (3)	E502T-F1	.05	.90	.55	.50		.55		Balance	
5055 (3)	E505T-1	.05	.90	.55	.90*		1.0		Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

- (1) To AWS A5.28, Consumables Used for Electrode Gas Welding
- (2) To AWS A5.28, Low Alloy Filler Metals for Gas Shielded Arc Welding
- (3) To AWS A5.22, Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes

**Table 7—McKAY SPEED ALLOY METAL CORED SUBMERGED ARC WELDING WIRES**  
 To AWS A5.23, Specification for Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding. Chemistry using L-TEC 80 Flux except as noted by (1), (2) and (3)

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH SPECIFIED FLUX, %								OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Copper Cu †	Iron Fe	
70-S	F7A4-ECG-G	.10	1.50	.40					Balance	Calcium Fluoride, (CaF <sub>2</sub> )
70B6-S	F7PO-ECB6-B6	.05	.90	.45	.50		.50		Balance	
70N1-S	F7P4-ECN1-N1	.06	1.0	.45		1.0	.25		Balance	
70N12-S	F7PB-ECN2-Ni2	.05	.90	.40		2.25			Balance	
70N13-S	F7P10-ECN3-Ni3	.05	.85	.40		3.40			Balance	
80A3-S	F8PO-ECA3-A3	.07	.90	.45			.55		Balance	
80B2-S	F8PZ-ECB2-B2	.05	1.00	.40	1.30		.50		Balance	
82B2-S (2)	F8PZ-ECB2-B2	.04	1.00	.50	1.30		.50		Balance	
80N13-S (1)	F8P10-ECN3-Ni3	.05	.85	.35		3.40			Balance	
80W-S	F8A2-ECW-W	.05	1.20	.50	.65	.60		.55	Balance	
90-S	F9AO-ECM1-M1	.09	1.30	.40		1.80	.20		Balance	
92-S (2)	F9A2-ECM1-M1	.08	1.30	.30		1.50	.15		Balance	
100B3-S	F10PZ-ECB3-B3	.10	.80	.40	2.25		1.05		Balance	
100F3-S (3)	F10P2-ECF3-F3	.09	1.50	.40		.85	.50		Balance	
110-S	F11A0-ECM3-M3	.06	1.60	.50		2.40	.45		Balance	
112-S (2)	F11A2-ECM3-M3	.06	1.70	.25		2.40	.45		Balance	
120-S	F12A0-ECM3-M3	.06	1.80	.50	.50	2.40	.45		Balance	
215513-S (2)	F8PZ-ECB2-B2	.05	.80	.25	1.25		.55		Balance	

\*We recommend air monitoring for fluorides on all the grades shown. The TLV/PEL for fluorides is 2.5 mg/m<sup>3</sup> as fluoride.

- (1) L-TEC 0091 Flux
- (2) Lincoln 680 Flux
- (3) Lincoln 682 Flux

**Table 8—McKAY STAINLESS STEEL AC-DC, DC LIME, DCT \*\* AND DCT-2 \*\* COVERED ELECTRODES  
To AWS A5.4, Specification for Covered Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %													OTHER COVERING INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Columbium Tantalum Cb + Ta	Copper Cu †	Tungsten W	Titanium Ti	Nitrogen N	Iron Fe		
308/308H**	E308/308H	.06	1.00	.40	20.2*	9.6								Balance	Oxides and/or Fluorides (F) of: Aluminum (Al) Calcium (Ca) Magnesium (Mg) Potassium (K) Sodium (Na) Titanium (Ti)
308HC	308HC(1)	.12	1.50	.30	19.0*	10.1								Balance	
308L**	E308L	.03	1.00	.40	20.2*	9.8								Balance	
309**	E309	.07	1.00	.35	23.4*	12.5								Balance	
309Cb	E309Cb	.07	1.00	.50	23.0*	13.0		.50						Balance	
309HC	None	1.1	2.00	.45	22.5*	12.5								Balance	
309Mo	E309Mo	.07	1.00	.40	22.3*	13.0	2.30							Balance	
309L**	E309L	.035	1.00	.50	23.0*	13.2								Balance	
309LMo	E309Mo	.03	.90	.35	22.5*	12.5	2.2							Balance	
310	E310	.13	2.10	.50	26.2*	21.0								Balance	
310H	310H	.40	2.25	.40	28.2*	21.4								Balance	
310Cb	E310Cb	.10	2.10	.45	26.0*	21.0		.55						Balance	
310Mo	E310Mo	.10	2.10	.45	26.0*	21.0	2.25							Balance	
312	E312	.10	1.30	.80	29.0*	9.0								Balance	
312Mo	None	.10	1.70	.60	29.0*	9.0	2.0							Balance	
316/316H	E316/316H	.06	1.85	.35	18.0*	13.0	2.15							Balance	
316/316H HF**	E316/316H	.04	1.20	.35	19.3*	11.5	2.35							Balance	
316L	E316L	.03	1.80	.35	18.0*	13.2	2.25							Balance	
Kryo-Kay 316L	E316L	.025	2.10	.30	17.7*	13.6	2.10							Balance	
316L HF**	E316L	.03	1.00	.35	19.5*	11.6	2.25							Balance	
317**	E317	.06	1.80	.45	18.4*	13.6	3.30							Balance	
317L**	E317L	.03	1.50	.45	18.4*	13.6	3.20							Balance	
318	E318	.05	1.75	.40	19.5*	12.5	2.30	.55						Balance	
320	E320	.04	2.25	.25	19.7*	32.9	2.15	.50	3.10*					Balance	
023	None	.04	2.25	.25	19.7*	32.9	2.15		3.10*					Balance	
330	E330	.20	2.25	.50	14.5*	34.0								Balance	
347**	E347	.05	1.20	.50	18.6*	9.8		.65						Balance	
349	E349	.10	1.20	.60	18.9*	8.7	.60	.95		1.40	.07			Balance	
410	E410	.08	.50	.40	11.8*									Balance	
410NiMo	E410NiMo	.05	.75	.40	11.7*	4.5	.50							Balance	
630	E630	.035	.45	.40	16.35*	4.75		.20	3.30*					Balance	
2209	None	.03	.95	.45	23.0*	9.7	3.0							Balance	
HP45Mod	None	.18	1.15	.40	25.8*	34.4								Balance	
N50W	E209	.04	5.50*	.40	22.0*	11.0	1.90				.23			Balance	
N35W	E240	.04	11.10*	.30	17.7*	5.2					.18			Balance	
Armorloy A-8	E307	.08	3.60	.50	20.2*	9.4	1.15							Balance	
Armorloy A-8	None	.10	1.85	.45	20.0*	9.5	2.1							Balance	

\* We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

\*\* DCT and DCT-2 Electrodes have higher deposit silicon and lower deposit manganese than the typical deposit chemistries shown.

(1) MIL E-22200/2

**Table 9—McKAY SPOOLED, COILED AND CUT LENGTH SOLID STAINLESS STEEL WIRES  
To AWS A5.9, Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare Arc Welding Electrodes  
and Welding Rods with Inert Gas Shielding or Submerged Arc Flux**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH GTA and ARGON, %												OTHER INGREDIENTS	
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Columbium Tantalum Cb + Ta	Copper Cu †	Vanadium V	Nitrogen N	Iron Fe			
308	ER308	.04	1.90	.45	20.5*	9.8								Balance	Only residual elements at the normal levels found in solid stainless steel wires
308L	ER308L	.017	1.80	.50	20.3*	9.7								Balance	
308L Hi Si	ER308L-Si	.017	1.80	.80	20.3*	9.7								Balance	
309	ER309	.06	1.75	.50	23.7*	12.7								Balance	
309L	ER309L	.016	2.00	.45	23.7*	13.2								Balance	
309L Hi Si	None	.016	2.00	.80	23.7*	13.2								Balance	
310	ER310	.10	1.80	.50	27.0*	21.1								Balance	
316	ER316	.04	1.70	.48	18.7*	12.7	2.30							Balance	
316L	ER316L	.019	1.70	.45	18.9*	12.5	2.20							Balance	
316L Hi Si	ER316L-Si	.015	1.80	.80	19.0*	12.0	2.20							Balance	
317L	ER317L	.020	1.75	.45	19.0*	13.3	3.20							Balance	
320	ER320	.020	.45	.25	19.7*	33.4	2.10	.40	3.20*					Balance	
330	ER330	.20	1.75	.35	16.0*	35.0								Balance	
347	ER347	.045	1.95	.45	19.7*	9.3		.75						Balance	
410	ER410	.08	.50	.40	12.9*									Balance	
630	ER630	.035	.60	.45	16.5*	5.0	.20	.20	3.0*					Balance	
023	None	.020	.45	.25	19.7*	33.4	2.10		3.20*					Balance	
N50W	ER209	.030	6.00*	.40	21.0*	10.0	1.80		.20	.20	.22			Balance	
N35W	ER240	.030	12.60*	.40	18.0*	5.0					.15			Balance	

\* We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

**Table 10—McKAY IN-FLUX O STAINLESS STEEL AND NICKEL BASE FLUX CORED OPEN ARC WELDING WIRES To AWS A5.22, Specification for Flux-Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes with No Gas Shielding**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %											OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Columbium Tantalum Cb + Ta	Copper Cu †	Titanium Ti	Nitrogen N	Iron Fe	
308-0	E308T-3	.05	1.20	.50	20.5*	9.9						Balance	Oxides and/or Fluorides (F) of: Calcium (Ca) Potassium (K) Titanium (Ti)
308L-0	E308LT-3	.02	1.20	.50	20.3*	10.2						Balance	
A9-0	None	.10	1.70	.55	20.5*	9.9	2.1					Balance	
309-0	E309T-3	.04	1.40	.50	23.8*	12.7						Balance	
309L-0	E309LT-3	.02	1.40	.50	23.6*	12.7						Balance	
309L-Mo-0	None	.02	1.40	.50	23.6*	12.7	2.2					Balance	
309CbL-0	E309CbLT-3	.02	1.20	.40	24.0*	12.9		.85				Balance	
Verticiled 9	None	.02	1.55	.30	27.7*	12.5						Balance	
310-0	E310T-3	.10	2.30	.40	26.1*	20.7						Balance	
310HC-0	None	.40	2.30	.40	26.1*	20.7						Balance	
312-0	E312T-3	.08	1.50	.30	29.5*	9.0						Balance	
316L-0	E316LT-3	.02	1.90	.50	18.9	12.0	2.4					Balance	
4K-0	None	.02	2.25	.30	17.8*	13.5	2.20					Balance	
317L-0	E317LT-3	.02	1.50	.50	20.0*	13.5	3.30					Balance	
347L-0	E347T-3	.02	1.10	.60	19.9	9.8		.60				Balance	
363-0	E410NIT-3	.03	.40	.40	11.3*	4.0			.40			Balance	
409-0	E409T-3	.04	.80	.60	12.0*				.70			Balance	
410-0	E410T-3	.09	.50	.30	12.0*							Balance	
410NiMo-0	E410NiMoT-3	.03	.50	.30	11.6*	4.4	.50					Balance	
430-0	E430T-3	.03	.55	.30	18.8*							Balance	
446-0	None	.02	.80	.40	26.0*							Balance	
530-0	None	.02	.80	.20	16.4*	4.7		.20	3.4*			Balance	
556HT-0	None	.02	.80	.30	25.0*	7.7	4.2			.18		Balance	
18115-0	None(1)	.02	2.00	.55	23.1*	13.0	2.8			.12		Balance	
2209-0	None	.02	1.60	.40	22.0*	8.5	3.30			.14		Balance	
259-0	None	.02	1.00	.30	25.0*	10.0	3.2			.14		Balance	
NiCr3-0	None	.02	3.20	.20	20.0*	Balance		2.40				1.3	
NiCrMo3-0	None	.02	.20	.20	20.5*	Balance	8.40	3.50				2.0	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

(1) 309L-Mo-0 Modified

**Table 11—McKAY IN-FLUX T1 AND T1-XHP STAINLESS STEEL FLUX CORED GAS SHIELDED WELDING WIRES To AWS A5.22, Specification for Flux-Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes with CO<sub>2</sub> or 75/25 Argon/CO<sub>2</sub> Shielding**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH 75/25 ARGON/CO <sub>2</sub> , %									OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Columbium Tantalum Cb + Ta	Iron Fe		
308-T1	E308T-1	.05	1.2	.06	19.7*	9.5				Balance	Oxides and/or Fluorides (F) of: Aluminum (Al), Potassium (K), Sodium (Na), Titanium (Ti), Zirconium (Zr)
308L-T1	E308LT-1	.03	1.2	.06	19.5*	9.5				Balance	
A9-T1	None	.09	1.4	.06	21.0*	9.5	2.2			Balance	
309-T1	E309T-1	.05	1.2	.06	23.5*	12.5				Balance	
309L-T1	E309LT-1	.03	1.2	.06	24.2*	12.5				Balance	
309L-Mo-T1	None	.03	1.2	.06	23.0*	12.5	2.3			Balance	
312-T1	E312T-1	.11	1.2	.06	29.0*	9.0				Balance	
316L-T1	E316LT-1	.03	1.2	.06	19.0*	12.0	2.3			Balance	
347-T1	E347T-1	.05	1.2	.06	19.5*	9.5		.6		Balance	
410 NiMo-T1	E410NiMoT-1	.03	.05	.04	11.8*	4.5	.60			Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

**Table 12—McKAY IN-FLUX G/S STAINLESS STEEL METAL CORED GAS SHIELDED/SUBMERGED ARC WELDING WIRES To AWS 5.9, Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored . . . Arc Welding Electrodes. For use with Inert Gas Shielding or Submerged Arc Flux.**

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY WITH GMA and 99% Argon/Oxygen, %										OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Columbium Tantalum Cb + Ta	Titanium Ti	Iron Fe		
308-G/S	ER308	.05	1.40*	.40	20.5*	10.0					Balance	Oxides and/or Fluorides (F) of: Aluminum (Al) Calcium (Ca) Potassium (K) Sodium (Na) See footnote ** on Fluorides.
308L-G/S	ER308L	.02	1.70*	.40	20.0*	10.3					Balance	
A9-G/S	None	.10	1.60*	.50	19.5*	9.5	2.00				Balance	
309L-G/S	ER309L	.02	1.80*	.50	24.0*	13.0					Balance	
309Cb-G/S	None	.02	1.80*	.50	23.1*	12.9		.80			Balance	
309HC-G/S	None	1.20	1.80*	.40	24.0*	13.0					Balance	
309L-Mo-G/S	None	.02	1.60*	.50	23.0*	12.8	2.50				Balance	
310-G/S	ER310	.12	1.60*	.50	26.7*	21.4					Balance	
312-G/S	ER312	.12	1.80*	.50	29.0*	9.0					Balance	
316L-G/S	EH316L	.02	1.60*	.40	19.0*	12.8	2.30				Balance	
317L-G/S	ER317L	.02	1.40*	.40	19.5*	14.0	3.50				Balance	
347L-G/S	ER347	.04	1.80*	.40	21.0*	10.0		.70			Balance	
409-G/S	None	.05	.50	.30	12.0				.70		Balance	
410-G/S	ER410	.10	.40	.20	12.3						Balance	
410NiMo-G/S	ER410NiMo	.02	.50	.30	12.0	4.5	.50				Balance	
430-G/S	ER430	.06	.40	.30	16.3*						Balance	
17610-G/S	None (1)	.12	.50	.40	12.1	.55	.30				Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

\*\* If used submerged arc, we recommend air monitoring for fluorides, which come primarily from the flux.

(1) 17610-G/S — 410 G/S Modified for higher strength

**Table 13—McKAY HARDALLOY SURFACING COVERED ELECTRODES**  
Covered manual electrodes for hardsurfacing steel parts.

McKAY GRADE	TYPICAL DEPOSIT CHEMISTRY, %											OTHER INGREDIENTS
	Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Titanium Ti	Vanadium V	Tungsten W	Columbium Cb	Iron Fe	
32	18	13	6	7		3					Balance	Most contain oxides and/or Fluorides (F) of: Aluminum (Al) Calcium (Ca) Magnesium (Mg) Potassium (K) Sodium (Na) Titanium (Ti) Zirconium (Zr)
40TIC	30	11	8	8.2*			1.5				Balance	
42	17	18	5	2.0		7		3			Balance	
44	17	2.2	4	2.0*							Balance	
48	18	1.2	1.5	30*	3.0	1.5					Balance	
52	6	1.4	6	2.5		4					Balance	
55	4.6	1.0	1.1	27*		3.5					Balance	
55TIC	60	2.8	10	13*			5.5				Balance	
58	6	1.2	7	5.5*		5					Balance	
58TIC	2.0	1.8	1.3	5.0*		5	2.7	.4		2.3	Balance	
81	8	5	7	4.0*		8.0		1.1	1.1		Balance	
118	8	16.5*	5	5.0	3						Balance	
119	1.0	19.5*	5	5.0*							Balance	
128	.07	1.3	6	23.5*	9.7						Balance	
140	3.0	4	2.0	30*		7					Balance	
M-932	13	8	4	2.2		10					Balance	
Chrome-Mang	4	14.5*	6	14.0*	1.0	1.5		5.5			Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

**Table 14—McKAY TUBE-ALLOY-O FLUX CORED OPEN ARC SURFACING WIRES**  
For open arc semi-automatic and automatic hardsurfacing of steel parts with no shielding gas

McKAY GRADE	TYPICAL DEPOSIT CHEMISTRY, %											OTHER INGREDIENTS
	Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Titanium Ti	Vanadium V	Tungsten W	Copper Cu †	Iron Fe	
218-0	1.0	15*	4	3.1	4						Balance	Most contain oxides and/or Fluorides (F) of: Aluminum (Al) Calcium (Ca) Magnesium (Mg) Potassium (K) Sodium (Na) Titanium (Ti)
219-0	1.2	20*	6	4.5							Balance	
230-0	.95	4.2*	5	15.3*							Balance	
240-0	3.2	1.8	1.8	15.5*							Balance	
240TIC-0	4.2	1.5	2.2	10.7			7.3				Balance	
242-0	1.4	1.6	6	2.5							Balance	
244-0	2.5	1.6	2.0	9.0		1.5				5	Balance	
252-0	2.5	1.5	7	3.5			7				Balance	
255-0	4.5	9	5	26.5*							Balance	
258-0	4.5	1.4	8	6.0*		1.5			1.5		Balance	
258TIC-0	2.1	1.3	1.8	7.0		1.6	6.0				Balance	
263-0	6.0	1.0	5	23.0*							Balance	
511-040	1.0	1.6	1.2	3.8*		4.5	8	20			Balance	
511-045	1.5	1.5	1.1	3.9*		5.0	8	20			Balance	
829-0	1.9	13*	6	3.0			3.5				Balance	
A43-0	5.5	0.2	1.0	22.0*	(1)						Balance	
A45-0	5.5	0.2	1.0	21.0*	(1)	6.5			1.5		Balance	
AP-0	4.2	16.5*	3	13.0*							Balance	
BU-A2	.50	18.4*	1.5	12.8*							Balance	
BU-0	.06	9	4	1.0			.5				Balance	
BU-CI	.07	1.0	6				1.0				Balance	
M932-0	1.1	1.3	6	1.3		5	8				Balance	

\*We recommend air monitoring for these. See Sections 5 and 6 and the labels on the product containers.

(1) Columbium, Cb, 6.5%

**Table 15—McKAY TUBE-ALLOY-S METAL CORED SUBMERGED ARC SURFACING WIRES**  
For submerged arc hardsurfacing of steel parts using L-TEC 50 Flux except as noted by (1), (2) and (3)

McKAY GRADE	TYPICAL DEPOSIT CHEMISTRY WITH SPECIFIED FLUX, %											OTHER INGREDIENTS
	Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Titanium Ti	Vanadium V	Tungsten W	Columbium Cb	Iron Fe	
236-S	1.5	1.6	6		5.3	5.5					Balance	Some of these wires contain titanium dioxide (TiO <sub>2</sub> ) and alumina (Al <sub>2</sub> O <sub>3</sub> ) see footnote * on fluorides
242-S	.16	1.9	8	1.6		6		2.2			Balance	
250-S (1)	2.0	1.3	8	11.0							Balance	
A250-S (2)	1.9	1.0	6	11.4							Balance	
252-S	1.8	2.1	9	3.5							Balance	
255-S	4.5	3.0	8	29.0							Balance	
258-S (2)	3.5	1.3	8	6.2		1.6			1.3		Balance	
821-S	1.6	1.2	6	6.0		1.4			1.1		Balance	
848-S	4.0	3.5	8	29.0							Balance	
881-S (2)	1.5	0.9	.55	1.5		5.5					Balance	
8820-S (2)	1.7	.8	4	5	5	2					Balance	
885-S (2)	1.8	1.1	4	12.0	2.7	1.0		.2		0.2	Balance	
888-S (2)	0.6	.6	6	13.0	4.5	9					Balance	
885-S MOD (3)	1.8	1.1	6	14.0	2.7	1.0		1.8		1.8	Balance	
420M-S (1)	2.5	1.2	7	14.0							Balance	
A420M-S (2)	2.3	1.2	7	14.0							Balance	
AP-S	3.0	15.5	1.4	12.0	1.2	1.3		3.5			Balance	
A2JL-S (2)	0.4	.8	5	12.5	2.0	1.0					Balance	
BU-S	1.2	1.8	8	7							Balance	

\*We recommend air monitoring for Fluorides, which comes from the flux. See Sections 5 and 6 and the labels on the product containers.

- (1) L-TEC 80 Flux
- (2) Lincoln 880 Flux
- (3) Cerlikon HND 24 Flux

Table 16—McKAY SPECIAL MAINTENANCE COVERED ELECTRODES, RODS AND WELDING WIRES

McKAY GRADE	ELECTRODE, ROD OR WIRE	TYPICAL DEPOSIT CHEMISTRY WITH SPECIFIED SHIELDING, %										OTHER INGREDIENTS	
		Carbon C	Manganese Mn †	Silicon Si	Chromium Cr †	Nickel Ni †	Molybdenum Mo	Vanadium V	Tungsten W	Cobalt Co †	Iron Fe		
McKay GP	Electrode	.06	1.0	5	26.5*	9.0						Balance	Most contain oxides and/or Fluorides (F) of: Aluminum (Al) Calcium (Ca) Magnesium (Mg) Potassium (K) Sodium (Na) Titanium (Ti)
McKay GP-O (1)	Wire	.07	1.5	8	30*	9.0						Balance	
Frogalloy	Electrode	4	4.1	5	19.2*	9.2	1.4					Balance	
Frogalloy-O (1)	Wire	4	4.1	5	19.2*	9.5	1.8					Balance	
McKay S7-T (2)	Wire	5	8	5	3.3		1.5					Balance	
McKay HW-T (2)	Wire	4	1.0	6	5.0		1.5	.4	1.3			Balance	
McKay HW2-T (2)	Wire	.11	8	5	4.3		1.3	.4	2.0			Balance	
McKay C	Electrode	.03	6	4	15.5*	Balance	16.0		3.8			3.5	
McKay C-G (3)	Wire	.04	.6	.6	15.5*	Balance	16.0		3.5			3.5	
McKay C-T1 (3)	Wire	.04	6	.6	15.5*	Balance*	16.0		4.0			3.5	
McKay C-S* (4)	Wire	.01	8	.8	14.3	Balance	15.3		3.8			3.5	
McKay 55Ni-O	Wire	1.1	4.0	0.6		53.0						Balance*	
Tool Age 40DS* (4)	Wire	.08	8	4	5.0		11.0				16.3	Balance	
Tool Forge 29 (3)	Wire	.07	1.3	7	.8	1.9	8					Balance	
Tool Forge 36 (3)	Wire	.09	1.2	6	5.2	1.0	1.5	.3	4			Balance	
Tool Forge 40 (3)	Wire	.08	6	4	5.0		11.0				16.3	Balance	
Tool Forge 855G (3)	Wire	.20	1.2	.8	10.7*	2.0	2.8	.3	6			Balance	
Hardalloy 8-B	Rod	1.1	0.02	1.0	28.5*	1.0	0.08		4.5	Balance*		1.3	
Hardalloy 6-C	Electrode	1.3	0.03	1.3	29.3*	1.3	0.1		4.8	Balance*		1.6	
Tube-Alloy 6-G	Wire	0.9	1.4	0.90	26.0*	2.0			3.6	Balance*		4.0	
Hardalloy 21-B	Rod	.25	.5	.50	27.0*	2.5	5.5			Balance*		1.5	
Hardalloy 21-C	Electrode	.25	.8	.70	27.0*	2.5	5.0			Balance*		1.5	
Tube-Alloy 21-G	Wire	.25	.8	.50	27.0*	1.5	5.0			Balance*		2.5	

\*We recommend air monitoring for these, and also for Fluorides, (primarily from the flux) on the -S wires. See Sections 5 and 6 and the labels on the product containers.

(1) with no gas shielding

(2) with Tri Mix gas shielding

(3) with CO<sub>2</sub> gas shielding

(4) with L-TEC 80 Flux

Table 17—McKAY CAST-ALLOY COVERED ELECTRODES FOR CAST IRON WELDING To AWS A5.15, Specification for Welding Electrodes and Rods for Cast Iron

McKAY GRADE	AWS CLASS	TYPICAL DEPOSIT CHEMISTRY, %						OTHER INGREDIENTS
		Carbon C	Manganese Mn †	Silicon Si	Copper Cu †	Iron Fe	Nickel Ni †	
Cast-Alloy	ENI-CI	1.1	4	2.7	1.4	5.5	Balance	Oxides and/or Fluorides (F) of: Aluminum (Al), Boron (B), Calcium (Ca), Magnesium (Mg), Silicon (Si), Sodium (Na), Strontium (Sr), and Zirconium (Zr)
Cast-Alloy 60	ENiFe-CI	1.3	.5	.8		Balance	49	
Cast-Alloy T-60	ENiFe-CI	1.3	.2	.8		Balance	46	

Section 3 & 4—PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE AND EXPLOSION HAZARD DATA

**Physical/Chemical Characteristics:** These products as shipped are nonhazardous, nonflammable, nonexplosive and nonreactive.  
**Fire and Explosion Hazard Data:** The welding arc and sparks (spatter) can ignite combustible and flammable materials.  
**Rating under National Fire Protection 704:** Health, 0; Flammability, 0; Reactivity, 0.

Section 5—REACTIVITY DATA—HAZARDOUS\* DECOMPOSITION PRODUCTS

\*The term "hazardous" should be interpreted as a term required and defined in the OSHA Hazard Communication Standard (29 CFR Part 1910. 1200) and does not necessarily imply the existence of any hazard.

These products as shipped are stable, nonhazardous, nonflammable, nonexplosive and nonreactive.

Welding fumes and gases cannot be classified simply. The composition and quality of both are dependent upon the metal being welded, the process, procedure and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities).

Most fume ingredients are present in complex combinations, rather than as separate compounds. Excessive overexposures may produce the effects outlined in Section 6, HEALTH HAZARD DATA, for Welding Fumes (TLV of 5 mg/m<sup>3</sup>).

Some fume ingredients have low PELs/TLVs and represent special potential health hazards, described in Section 6. Tetradyne McKay recommends monitoring all chemicals marked with an asterisk (\*) in Section 2. Where monitoring is suggested, these chemicals are specifically shown on the product labels under the heading "Health Protection and Ventilation". As shown on the product labels in those cases, they will or may exceed their PEL/TLV before the total welding fume exceeds its TLV of 5 mg/m<sup>3</sup>.

Table 1—McKAY MILD STEEL COVERED ELECTRODES

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 1, Section 2	Complex oxide combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for the oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume.

Table 2—McKAY MILD STEEL SOLID WELDING WIRES

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 2, Section 2	Complex oxide combinations of all wire ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen. If the shielding gas contains argon, also check ozone. If the shielding gas is carbon dioxide, check for carbon monoxide.	5 mg/m <sup>3</sup> of Welding Fume 0.1 mg/m <sup>3</sup> of copper

**Table 3—McKAY MILD STEEL LOW HYDROGEN COVERED ELECTRODES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 3, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for gaseous fluorides and/or oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume

**Table 4—McKAY SPEED-ALLOY MILD STEEL FLUX CORED GAS SHIELDED WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 4, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide	5 mg/m <sup>3</sup> of Welding Fume 1 mg/m <sup>3</sup> of manganese on grades with an * on Mn in Table 4, Section 2

**Table 5—McKAY LOW ALLOY LOW HYDROGEN COVERED ELECTRODES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 5, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for gaseous fluorides and/or oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume 0.05 mg/m <sup>3</sup> of Cr VI on grades with an * on Cr in Table 5, Section 2

**Table 6—McKAY SPEED-ALLOY LOW ALLOY FLUX CORED GAS SHIELDED WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 6, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide	5 mg/m <sup>3</sup> of Welding Fume 1 mg/m <sup>3</sup> of manganese on grades with an * on Mn in Table 6, Section 2

**Table 7—McKAY SPEED-ALLOY METAL CORED SUBMERGED ARC WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 7, Section 2	Few, mostly fluorides, but containing oxides of all metals in the wire and flux.	Normally low. If any symptoms indicate the need, check for gaseous fluorides.	5 mg/m <sup>3</sup> of Welding Fume Fluorides, 25 mg/m <sup>3</sup> as fluoride, all grades

**Table 8—McKAY STAINLESS STEEL COVERED ELECTRODES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 8, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for gaseous fluorides and/or oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume 0.05 mg/m <sup>3</sup> of Cr VI on all grades in Table 8, Section 2 0.1 mg/m <sup>3</sup> of copper on grades with an * on Cu in Table 8, Section 2 1 mg/m <sup>3</sup> of manganese on grades with an * on Mn in Table 8, Section 2

**Table 9—McKAY STAINLESS STEEL SOLID WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 9, Section 2	Complex oxide combinations of all wire ingredients	Normally low. If any symptoms indicate the need, check for ozone and/or oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume 0.5 mg/m <sup>3</sup> of Cr II plus III on all grades in Table 9, Section 2 0.1 mg/m <sup>3</sup> of copper on grades with an * on Cu in Table 9, Section 2 1 mg/m <sup>3</sup> of manganese on grades with an * on Mn in Table 9, Section 2

**Table 10—McKAY IN-FLUX O STAINLESS STEEL AND NICKEL BASE FLUX CORED OPEN ARC WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 10, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide	5 mg/m <sup>3</sup> of Welding Fume 0.05 mg/m <sup>3</sup> of Cr VI on all grades in Table 10, Section 2 0.1 mg/m <sup>3</sup> of copper on any grade with an * on Cu in Table 10, Section 2



**Table 11—McKAY IN-FLUX T1 AND T1-XHP STAINLESS STEEL FLUX CORED GAS SHIELDED WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 11, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide.	5 mg/m <sup>3</sup> of Welding Fume
			0.05 mg/m <sup>3</sup> of Cr VI on all grades in Table 11, Section 2
			0.5 mg/m <sup>3</sup> of Cr II plus III on all grades in Table 11, Section 2

**Table 12—McKAY IN-FLUX G/S STAINLESS STEEL METAL CORED GAS SHIELDED/SUBMERGED ARC WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 12, Section 2	Submerged arc Few, mostly fluorides	Low, gaseous fluorides	2.5 mg/m <sup>3</sup> of fluorides on all grades in Table 12, Section 2
	Gas shielded Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide and/or ozone.	5 mg/m <sup>3</sup> of Welding Fumes 1 mg/m <sup>3</sup> of manganese on all grades with an * on Mn in Table 12, Section 2 0.5 mg/m <sup>3</sup> of Cr II plus Cr III on all grades with an * on Cr in Table 12, Section 2

**Table 13—McKAY HARDALLOY SURFACING COVERED ELECTRODES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 13, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for the oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume
			0.05 mg/m <sup>3</sup> of Cr VI on all grades with an * on chromium in Table 13, Section 2
			0.5 mg/m <sup>3</sup> of Cr II plus Cr III on all grades where listed on product label
			1 mg/m <sup>3</sup> of manganese on all grades with an * on Mn in Table 13, Section 2

**Table 14—McKAY TUBE-ALLOY-O FLUX CORED OPEN ARC SURFACING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 14, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for the oxides of nitrogen, and/or gaseous fluorides and/or carbon monoxide.	5 mg/m <sup>3</sup> of Welding Fume
			1 mg/m <sup>3</sup> of manganese on all grades with an * on Mn in Table 14, Section 2
			0.05 mg/m <sup>3</sup> of Cr VI and/or 0.5 mg/m <sup>3</sup> of Cr II plus Cr III where chromium has an * in Table 14. Product label indicates whether Cr VI or Cr II plus III.

**Table 15—McKAY TUBE-ALLOY-S METAL CORED SUBMERGED ARC SURFACING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 15, Section 2	Few, mostly fluorides	Normally low. If any symptoms indicate the need, check for gaseous fluorides.	2.5 mg/m <sup>3</sup> of fluoride on all grades in Table 15, Section 2

**Table 16—McKAY SPECIAL MAINTENANCE COVERED ELECTRODES, RODS AND WELDING WIRES**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS) FOLLOWING APPLY TO BOTH ELECTRODES AND WIRES.
All grades, Table 16, Section 2 ELECTRODES	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume
			0.05 mg/m <sup>3</sup> of Cr VI on all grades with an * on chromium in Table 16, Section 2
All grades, Table 16, Section 2 WIRES	Complex oxide and fluoride combinations of all wire ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen and/or gaseous fluorides and/or carbon monoxide and/or ozone.	1.0 mg/m <sup>3</sup> of nickel on all grades with an * on the nickel in Table 16, Section 2
			5 mg/m <sup>3</sup> of Welding Fume
			0.05 mg/m <sup>3</sup> of Cr VI on all grades with an * on chromium in Table 16, Section 2

**Table 17—McKAY CAST-ALLOY COVERED ELECTRODES FOR CAST IRON WELDING**

McKAY GRADES	FUMES TO BE EXPECTED	GASES TO BE EXPECTED	RECOMMENDED AIR MONITORING (VALUE AND INGREDIENTS)
All grades, Table 17, Section 2	Complex oxide and fluoride combinations of all electrode ingredients	Normally low. If any symptoms indicate the need, check for oxides of nitrogen.	5 mg/m <sup>3</sup> of Welding Fume.

Section 6 — EXPOSURE LIMITS AND HEALTH HAZARD INFORMATION

**ROUTE OF ENTRY:** The major route of entry of these fumes and gases is by inhalation. Where dermatitis or allergies are involved, it may also be by skin contact.

**AGGRAVATION** of preexisting respiratory or allergic conditions may occur in some welders. Where exposure data relating to respiratory illness to welders is available, the levels which those welders were exposed were excessively above recommended levels. Some studies have shown a higher level of lung related problems among older welders who smoked than those who did not smoke.

**EMERGENCY AND FIRST AID:** Remove from exposure and obtain prompt medical attention. If victim is unconscious, administer oxygen. If not breathing, resuscitate immediately. Employ first aid techniques recommended by American Red Cross.

Teledyne McKay recommends monitoring the fumes (and gases) for the components marked with an asterisk (\*) in Section 2. These components are also specifically shown on the individual product labels under the heading "Health Protection and Ventilation." These are the components most likely to exceed their limits before the total welding fume exceeds its recommended limit.

**MOST WELDING FUMES**

For virtually all carbon steel (mild steel), most low alloy, and some special welding electrodes, the ACGIH Welding Fumes Total Particulate (not otherwise classified) TLV of 5 mg/m<sup>3</sup> will be exceeded well before the PEL or TLV for any individual chemical in the fume is exceeded. The welding fume may contain many of the following chemicals. These will not be listed in the detailed HEALTH HAZARD TABLE presented later in this Section because (1) they are not present in the pure form, but only as complex combinations with many of the other ingredients (they can be considered pseudo minerals) and (2) they will be below their PEL or TLV when the total welding fume reaches its TLV of 5 mg/m<sup>3</sup>. This MSDS and our product labels show all exceptions to this general rule.

Note that many of the metals and chemicals listed in the HEALTH HAZARD TABLE later in this section are also present in many or most of these welding fumes, but at levels such that the 5 mg/m<sup>3</sup> for Welding Fumes is the critical exposure to monitor.

METAL OR CHEMICAL	SYMBOL	CAS NUMBER	METAL OR CHEMICAL	SYMBOL	CAS NUMBER	METAL OR CHEMICAL	SYMBOL	CAS NUMBER
Aluminum	Al	7429-90-5	Magnesium	Mg	7439-95-4	Strontium	Sr	7440-24-6
Aluminum oxide	Al <sub>2</sub> O <sub>3</sub>	1344-28-1	Magnesium oxide	MgO	1309-48-4	Strontium oxide	SrO	1314-11-0
Boron	B	7440-42-8	Molybdenum	Mo	7439-98-7	Titanium	Ti	7440-32-6
Boron oxide	B <sub>2</sub> O <sub>3</sub>	1303-86-2	Molybdenum oxide	MoO <sub>3</sub>	18868-43-4	Titanium oxide	TiO <sub>2</sub>	13463-07-7
Columbium (Niobium)	Cb (Nb)	7440-03-1	Potassium	K	7440-09-7	Tungsten	W	7440-33-7
Cb or Nb oxide	Ch <sub>2</sub> O <sub>4</sub> (Nb <sub>2</sub> O <sub>5</sub> )	1313-96-8	Potassium oxide	K <sub>2</sub> O	12136-47-7	Tungsten oxide	See over	39318-18-8
Calcium	Ca	7440-70-2	Silicon	Si	7440-21-3	Vanadium	V	7440-82-2
Calcium oxide	CaO	1305-78-8	Silicon oxide (amorphous)	SiO <sub>2</sub>	7831-86-9	Vanadium oxide	V <sub>2</sub> O <sub>5</sub>	1314-62-1
Lithium	Li	7439-93-2	Sodium	Na	7440-23-5	Zirconium	Zr	7440-67-7
Lithium oxide	Li <sub>2</sub> O	12057-24-8	Sodium oxide	Na <sub>2</sub> O	1313-59-3	Zirconium oxide	ZrO <sub>2</sub>	1314-23-4

**FUMES OF SPECIAL CONCERN**

Some electrodes contain alloying elements which may or do reach their PEL or TLV in the fumes before the total welding fumes reach 5 mg/m<sup>3</sup>. These special cases are shown both on the product labels for each container of electrodes and in Section 2 of this MSDS by means of an asterisk (\*). (See also the latest Teledyne McKay SAFETY AND HEALTH BULLETIN (SHB-3) for a more detailed discussion.) The elements or compounds of concern are also listed in the tables in Section 5 and in the tables in this section.

OSHA (29 CFR 1910.1200) specifies that chromium VI, nickel and its compounds must be considered as carcinogens because they are so classified by NTP and/or IARC. Many of our welding products contain chromium and nickel, as shown on the Tables on pages 2 thru 7 of this MSDS. While certain chromium and nickel compounds have been clearly shown to be animal and human carcinogens, these compounds have not been found in welding fumes. We believe that there are no reliable scientific studies which show that stainless steel welders or any welders or workers exposed to alloys containing significant chromium and/or nickel run increased risks of lung cancer because of their exposure to the forms of chromium and nickel found in the fumes.

OSHA also specifies that all welding fumes and gases be considered as possible carcinogens to humans because they are so classified by IARC. We believe that consideration of all available studies shows inadequate evidence of any significant carcinogenic risk from welding fumes and gases to individuals when exposures are held within OSHA mandated limits.

**HEALTH HAZARD TABLE**

The following tables show the compounds which have been discussed previously and which may be encountered, their names and formulas, their CAS number, their maximum allowable exposure limits per OSHA (Values of PEL, STEL, or Ceiling effective 9/1/89, Federal Register, Volume 52, No. 12, Air Contaminants, Final Rule, Table Z-1-A) and ACGIH (Values of TLV, STEL or Ceiling), and briefly describes possible known short term and long term health effects which may result from excessive exposure. (Sources—McKay Health Hazard Determination, TSCA list for CAS numbers, NIOSH/OSHA Pocket Guide to Chemical Hazards, and ACGIH Documentation of the Threshold Limit Values)

NAME OF COMPOUND, FORMULA AND CAS NUMBER	ALLOWABLE EXPOSURE LIMIT AS ELEMENT UNLESS OTHERWISE INDICATED. PEL, STEL, CEILING, OR TLV.	ON ANY CARCINOGENS LIST? IF SO, WHICH ONES?	POTENTIAL HEALTH EFFECTS RESULTING FROM EXCESSIVE OVEREXPOSURES	
			Acute (Short Term)	Chronic (Cumulative Long Term)
<b>WELDING FUMES AND COMPONENTS OF WELDING FUMES</b>				
Welding Fumes (Not otherwise classified)	PEL — 5 mg/m <sup>3</sup>	Yes IARC	May include metallic taste, nausea, tightness of chest, fever, dizziness, dryness or irritation of eyes, nose or throat.	Excessive levels may cause bronchial asthma, lung fibrosis, pneumoconiosis or "siderosis"
CAS No. — none	TLV — 5 mg/m <sup>3</sup>	See comments on page 10 under FUMES OF SPECIAL CONCERN. See also gases shown later in this table—Some of the above effects may come from the gases present.		

NAME OF COMPOUND, FORMULA AND CAS NUMBER	ALLOWABLE EXPOSURE LIMIT AS ELEMENT UNLESS OTHERWISE INDICATED. PEL, STEL, CEILING, OR TLV.	ON ANY CARCINOGENS LIST? IF SO, WHICH ONES?	POTENTIAL HEALTH EFFECTS RESULTING FROM EXCESSIVE OVEREXPOSURES	
			Acute (Short Term)	Chronic (Cumulative Long Term)
<b>WELDING FUMES AND COMPONENTS OF WELDING FUMES</b>				
The following specific fume components are listed roughly in their order of their estimated importance in terms of frequency of occurrence and/or potential hazard.				
Manganese—Mn CAS no. 7439-96-5 Manganese dioxide—MnO <sub>2</sub> CAS No. 1313-13-9	PEL — 1 mg/m <sup>3</sup> STEL — 3 mg/m <sup>3</sup> TLV for fume — 1 mg/m <sup>3</sup> as Mn	No	Can include metal fume fever, dry throat, coughing, tight chest, low back pain, vomiting, fatigue, headache.	"Manganism". Sensitivity varies. Affects central nervous system. Muscular weakness, tremors, symptoms similar to Parkinson's disease. <b>Exposed employees should get quarterly medical examinations for manganism.</b>
Chromium VI—Cr VI Sodium Chromate Na <sub>2</sub> CrO <sub>4</sub> (soluble) CAS No. 7775-11-3 Potassium Chromate K <sub>2</sub> CrO <sub>4</sub> (soluble) CAS No. 7789-00-6	PEL — 1 mg/10m <sup>3</sup> as CrO <sub>4</sub> which equals 0.05 mg/m <sup>3</sup> as Cr VI. TLV — 0.05 mg/m <sup>3</sup>	Yes IARC NTP	Allergic reaction in some people. Irritation of mucous membranes.	Compounds are dissolved, and excreted or modified to Cr II or Cr III.
See comments on page 10 under FUMES OF SPECIAL CONCERN.				
Chromium—Cr CAS No. 7440-47-3 Chromium oxide (Cr II) CrO CAS No. 12018-00-7 Chromium oxide (Cr III) Cr <sub>2</sub> O <sub>3</sub> CAS No. 1308-38-9	Present as oxides PEL — 0.5 mg/m <sup>3</sup> TLV — 0.5 mg/m <sup>3</sup>	No	Allergic reaction in some people.	None known.
Nickel—Ni CAS No. 7440-02-0 Nickel oxide—NiO CAS No. 1313-99-1	PEL — 1 mg/m <sup>3</sup> TLV — 1 mg/m <sup>3</sup>	Yes IARC NTP	Allergic reactions in some people. Metallic taste, nausea, tightness in chest, metal fume fever.	None known.
See comments on page 10 under FUMES OF SPECIAL CONCERN.				
Calcium Fluoride CaF <sub>2</sub> (insoluble) CAS No. 7789-75-5 Sodium Fluoride Na F (soluble) CAS No. 7681-49-4 Potassium Fluoride K F (soluble) CAS No. 7789-23-3 Aluminum Fluoride Al F <sub>3</sub> (insoluble) CAS No. 7784-18-1 Lithium Fluoride Li F (slightly soluble) CAS No. 7789-24-4	PEL — 2.5 mg/m <sup>3</sup> (as fluorine) TLV — 2.5 mg/m <sup>3</sup> (as fluorine)	No	CaF <sub>2</sub> probably inert. Soluble fluorides may be irritants and corrosive to mucous membranes.	Soluble portions may cause osteoporosis and mottling of teeth, but effects seem reduced in presence of iron as in welding electrode fume.
Iron—Fe CAS No. 7439-89-6 Iron Oxide—FeO CAS No. 1345-25-1 Iron Oxide—Fe <sub>2</sub> O <sub>3</sub> CAS No. 1309-37-1 Iron Oxide—Fe <sub>3</sub> O <sub>4</sub> CAS No. 1309-38-2	Use the PEL/TLV for welding fume. You will exceed it before you exceed the Fe TLV of 5.0 mg/m <sup>3</sup>	No	Probably none, except as nuisance dust.	Possible siderosis if exposures are excessive and long term. Regarded as benign. Lungs clear gradually after exposure is ended.
Copper—Cu CAS No. 7440-50-8 Copper oxide—CuO CAS No. 1317-38-0	PEL — 0.1 mg/m <sup>3</sup> for fume TLV — 0.2 mg/m <sup>3</sup> for fume	No	Metal fume fever, muscle ache, respiratory irritant.	None known.
Cobalt—Co CAS No. 7440-48-4 Cobalt Oxide—CoO CAS No. 1307-9606	PEL — 0.05 mg/m <sup>3</sup> TLV — 0.05 mg/m <sup>3</sup>	No	Pulmonary irritant, cough, dermatitis.	Possible lung fibrosis and respiratory hypersensitivity.

NAME OF COMPOUND, FORMULA AND CAS NUMBER	ALLOWABLE EXPOSURE LIMIT AS ELEMENT UNLESS OTHERWISE INDICATED. PEL, STEL, CEILING, OR TLV.	ON ANY CARCINOGENS LIST? IF SO, WHICH ONES?	POTENTIAL HEALTH EFFECTS RESULTING FROM EXCESSIVE OVEREXPOSURES	
			Acute (Short Term)	Chronic (Cumulative Long Term)
<b>GASES GENERATED BY OR PRESENT IN ARC WELDING PROCESSES</b>				
Fluorides, such as Silicon Tetrafluoride SiF <sub>4</sub> CAS No. 7783-61-1 Hydrogen fluoride HF CAS No. 7664-39-3	See soluble fluorides portion under Welding Fumes.			
Nitric oxide—NO CAS No. 10102-43-9	PEL — 25 ppm (30 mg/m <sup>3</sup> ) TLV — 25 PPM	No	Irritant to mucous membranes, drowsiness.	Chronic respiratory disease.
Nitrogen dioxide NO <sub>2</sub> CAS No. 10102-44-0	STEL (OSHA) — 1 ppm (1.8 mg/m <sup>3</sup> ) TLV — 3 ppm	No	Irritant to mucous membranes, coughing, chest pain, pulmonary edema.	Chronic respiratory disease.
Ozone—O <sub>3</sub> CAS No. 10028-15-6	PEL—0.1 ppm (0.2 mg/m <sup>3</sup> ) STEL (OSHA) — 0.3 ppm CEILING (ACGIH) -0.1 ppm	No	Irritant to mucous membranes, pulmonary edema.	Chronic respiratory disease.
Carbon monoxide—CO CAS No. 630-08-0	PEL—35 ppm (40 mg/m <sup>3</sup> ) CEILING (OSHA) — 200 ppm (229 mg/m <sup>3</sup> )	No	Headache, rapid breathing, oxygen deprivation, confusion, dizziness, weakness	Oxygen deprivation.
Argon—A Carbon dioxide—CO <sub>2</sub> Helium—He Nitrogen—N <sub>2</sub>	Regarded as simple asphyxiants	No	Inert gases which may replace air and deprive the body of oxygen. CO <sub>2</sub> is not inert but effect is as above. TWA — 10,000 ppm (18,000 mg/m <sup>3</sup> ) STEL — 30,000 ppm (54,000 mg/m <sup>3</sup> )	

**Section 7 & 8 -- PRECAUTIONS FOR SAFE HANDLING AND USE / CONTROL MEASURES**

Welding hazards are complex. Available accident and health records show that the great majority of the recorded problems result from physical accidents (sometimes due to electric shock or restricted visibility/mobility), physical strains, radiation burns such as eye "flash", heat burns due to hot metal or spatter, or metal fume fever.

Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1, Safety in Welding and Cutting published by the American Welding Society, P.O. Box 351040, Miami, FL 33135, the OSHA Publication 2206 (29CFR1910), US Government Printing Office, Washington, D.C. 20402 and the McKay SAFETY AND HEALTH BULLETIN of July 1986, August 1986 or later for more detail on many of the following.

**EXPOSURES:** Maintain all exposures below the limits shown on the warning on the package and on the product label. Use industrial hygiene air monitoring to ensure acceptable exposures. The air monitoring methods given in AWS F1.1 (latest edition) "Method of Sampling Airborne Particulates Generated by Welding and Allied Processes" and AWS F1.5 (latest edition) "Methods for Sampling and Analyzing Gases from Welding and Allied Processes." are considered appropriate for air monitoring. An overall strategy for air monitoring is given in AWS F1.3 (latest edition) "Evaluating Contaminants in the Welding environment - A Sampling Strategy Guide."

**VENTILATION:** Use enough ventilation, local exhaust at the arc, or both, to keep the fumes and gases from the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes. If fumes are removed by filtration or some other means and the air/gas stream put back in the room, the toxic gas levels may build up to undesirable levels. Toxic gases should be monitored, and/or be removed by some effective supplementary device, and/or reduced by general ventilation.

**RESPIRATORY PROTECTION:** Use respirable fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below the PEL or TLV.

**EYE PROTECTION:** Wear helmet or use face shield. As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade (a lower number shade) which gives sufficient view of the weld zone. See Z49.1 mentioned earlier in this section if more details are needed.

**PROTECTIVE CLOTHING:** Wear hand, head, and body protection which help to prevent injury from radiation, sparks, and electrical shock. See Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats shoulder protection, as well as dark substantial clothing.

**ELECTRICAL:** Train welder to avoid electrical shock by maintaining a dry work area, insulating himself from work and ground, and not touching live electrical parts.

**WASTE DISPOSAL:** Dispose of fume or flux or welding grinding residues from the work area or from filters in accordance with EPA or local regulations. Refer to Section 2 for information on components in the flux and to Sections 5 and 6 for information on components in the fumes.

**Section 9 -- SECTION 313 SUPPLIER NOTIFICATION**

The chemicals reportable by Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) are marked by the symbol † in Section 2, Tables 1 through 17. Refer to Section 2 for the percent of the chemical(s) in a particular product. Refer to the Tables in Section 6 for the CAS Number of reportable chemicals.

Teledyne McKay believes this information to be accurate and to reflect qualified expert opinion regarding research available to this date. However, Teledyne McKay cannot make any express or implied warranty as to this information.

