

G104 - 309, Gas Metal Arc Welding (GMAW) Welding Process Emission Factors

CALCULATION METHODS

Annual Emissions: $E_a = U_a \times EF \text{ (lbs/lb rod)} \times (1-e)$
 Hourly Emissions: $E_h = U_h \times EF \text{ (lbs/lb rod)} \times (1-e)$

E_a = Annual emissions of each listed toxic air contaminant per welding rod, (lbs/year)
 E_h = Maximum hourly emissions of each listed toxic air contaminant per welding rod, (lbs/hour)
 U_a = Annual usage of each welding rod, (lbs/year)
 U_h = Maximum hourly usage of each welding rod, (lbs/hour)
 EF = Emission Factor (lbs/lb rod)

Emission Factors:

- (1) Complete AP-42 information from Final Section 12.19 (1/95): EF = Trace Metal EF (Table 12.19-2)
- (2) Incomplete AP-42 Final Section 12.19 (1/95): EF = FGR (Table 12.19-1) x FCF x Ci (MSDS)
- (3) No AP-42 information but known welding process: EF = FGR (District Default) x FCF x Ci (MSDS)
- (4) District Study or AWMA information: EF = Trace Metal EF
- (5) Incomplete District Study information: EF = FGR (District Study) x FCF x Ci (MSDS)
- (*) Incomplete AP-42, District, or AWMA Hexavalent Chromium information: EF = Cr (Total Chromium in Fumes) EF x HCR

NOTES:

- Emission factors assume "uncontrolled" releases. Emission control methods and efficiencies reported are to be applied within the emission calculations.
- Fume generation rates (FGR) are based on the following:
 - EPA AP-42 Final Section 12.19 (1/95) Table 12.19-1 (PM10 EF)
 - ARB, Richard Bode: 0.01 (GMAW, TIG, MIG), 0.02 (SMAW, FCAW), 0.00005 (SAW), 0.05 (unspecified)
- Fume Correction Factors (FCF) per District engineering discussions with Industry:
 - 0.5464 (GMAW, TIG, MIG), 0.2865 (SMAW, FCAW, SAW), 1.0 (unspecified)
- Trace metal emission factors are based on the following:
 - AWMA Volume 59, 2009, Issue 5 (Pages 619-626) Table 2 and Table 3
 - EPA AP-42 Final Section 12.19 (1/95) Table 12.19-2
 - District engineering estimates using rod compositions (Ci) from MSDS
- Hexavalent chromium conversion rates (HCR) are per District engineering reviews of studies on welding:
 - 0.05 (GMAW, TIG, MIG), 0.55 (SMAW), 0.0005 (SAW), 0.10 (FCAW, unspecified)

POLLUTANT	DISTRICT EMISSION FACTORS (lbs/lb rod)	REFERENCE DOCUMENT	FACTOR	(UNITS)	COMMENTS
NOX					
CO					
SOX					
TOG					
VOC					
TSP	1.00E-02				Assume PM10 = TSP
PM10	1.00E-02	CARB Welding Recommendations (1993)	0.01	lbs/lb rod	Assume PM10 = Fume Generation Rate (FGR)
Al					
Al2O3					
Be					
Cd					

Co					
Cr	7.61E-03	AWMA Table 2	7.61	lb/1000 lbs rod	District Procedure (4) EF = Cr/Cr+6 EF
Cr(VI)	8.01E-05	AWMA Table 2	0.0801	lb/1000 lbs rod	District Procedure (4) EF = Cr/Cr+6 EF
Cu	3.82E-06	District Welding Study SDS - Lincoln Techalloy 309/309L	0.07	wt%	District Procedure (3) EF = FGR x FCF x Ci
Mn	8.74E-05	District Welding Study SDS - Lincoln Techalloy 309/309L	1.6	wt%	District Procedure (3) EF = FGR x FCF x Ci
Ni	7.43E-04	District Welding Study SDS - Lincoln Techalloy 309/309L	13.6	wt%	District Procedure (3) EF = FGR x FCF x Ci
P	1.09E-06	District Welding Study SDS - Lincoln Techalloy 309/309L	0.02	wt%	District Procedure (3) EF = FGR x FCF x Ci
Pb					
Crystalline Silica					
V					
Zn					

REFERENCES:

EPA AP-42 Chapter 12.19: <https://www.epa.gov/sites/production/files/2020-11/documents/c12s19.pdf>
 AWMA: <https://www.tandfonline.com/doi/abs/10.3155/1047-3289.59.5.619>

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