

**G116 - 5786, 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					

<b>Co</b>	1.37E-04	District Welding Study SDS - Haynes Hastelloy W	2.5	wt%	District Procedure (3) EF = FGR x FCF x Ci
<b>Cr</b>	2.73E-04	District Welding Study SDS - Haynes Hastelloy W	5	wt%	District Procedure (3) EF = FGR x FCF x Ci
<b>Cr(VI)</b>	1.37E-05	AWMA Page 623	5	%	District Procedure (*) EF = Cr EF x HCR
<b>Cu</b>					
<b>Mn</b>	5.46E-05	District Welding Study SDS - Haynes Hastelloy W	1	wt%	District Procedure (3) EF = FGR x FCF x Ci
<b>Ni</b>	3.44E-03	District Welding Study SDS - Haynes Hastelloy W	63	wt%	District Procedure (3) EF = FGR x FCF x Ci
<b>P</b>					
<b>Pb</b>					
<b>Crystalline Silica</b>					
<b>V</b>	3.28E-05	District Welding Study SDS - Haynes Hastelloy W	0.6	wt%	District Procedure (3) EF = FGR x FCF x Ci
<b>Zn</b>					

**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>