S111 - 4643, Shielded Metal Arc Welding (SMAW) Welding Process Emission Factors

CALCULATION METHODS

Annual Emissions: Ea = Ua x EF (lbs/lb rod) x (1-e)
Hourly Emissions: Eh = Uh x EF (lbs/lb rod) x (1-e)

Ea = Annual emissions of each listed toxic air contaminant per welding rod, (lbs/year)
Eh = Maximum hourly emissions of each listed toxic air contaminant per welding rod, (lbs/hour)
Ua = Annual usage of each welding rod, (lbs/year)
Uh = 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 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	2.00E-02				Assume PM10 = TSP
PM10	2.00E-02	CARB Welding Recommendations (1993)	0.02	lbs/lb rod	Assume PM10 = Fume Generation Rate (FGR)
Al					
Al2O3					
Be	4.58E-08	District Welding Study SDS - WA Alloy 4643 Aluminum	0.0008	wt%	District Procedure (3) EF = FGR x FCF x Ci
Cd					

Co					
Cr					
Cr(VI)					
Cu	5.73E-06	District Welding Study SDS - WA Alloy 4643 Aluminum	0.1	wt%	District Procedure (3) EF = FGR x FCF x Ci
Mn	2.87E-06	District Welding Study SDS - WA Alloy 4643 Aluminum	0.05	wt%	District Procedure (3) EF = FGR x FCF x Ci
Ni					
P					
Pb					
Crystalline Silica					
V					
Zn	5.73E-06	District Welding Study SDS - WA Alloy 4643 Aluminum	0.1	wt%	District Procedure (3) EF = FGR x FCF x Ci

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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