**G105 - 316, Gas Metal Arc Welding (GMAW) Welding Process Emission Factors**

**CALCULATION METHODS**

Annual Emissions:  \( Ea = U_a \times EF \times (1-e) \)

Hourly Emissions:  \( Eh = U_h \times EF \times (1-e) \)

- \( Ea \) = 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)
- \( U_a \) = 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): \( EF = \text{Trace Metal EF} \) (Table 12.19-2)
2. Incomplete AP-42 Final Section 12.19 (1/95): \( EF = \text{FGR (Table 12.19-1) x FCF x Ci (MSDS)} \)
3. No AP-42 information but known welding process: \( EF = \text{FGR (District Default) x FCF x Ci (MSDS)} \)
4. District Study or AWMA information: \( EF = \text{Trace Metal EF} \)
5. Incomplete District Study information: \( EF = \text{FGR (District Study) x FCF x Ci (MSDS)} \)

\( (*) \) Incomplete AP-42, District, or AWMA Hexavalent Chromium information: \( EF = \text{Cr (Total Chromium in Fumes) EF x HCR} \)

**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)

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**REFERENCES:**
- AWMA: https://www.tandfonline.com/doi/abs/10.3155/1047-3289.59.5.619

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