Air Permits Division

Calculations Guidance Package

Metal Spraying

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I. INSTRUCTIONS

This manual was developed for the purpose of providing a guide for calculating emissions at metal spraying facilities. Tables are provided for identifying the required input data and calculating emissions. In most cases, the upper portions of the tables are used to record input data/calculation parameters. Use the equations which follow the table to perform the emission calculations and record the results in the lower portion of the table.

NOTE: The applicant should complete these forms for maximum operating conditions and actual equipment specifications for the facility. For deposit efficiency and control device efficiency, refer to the manufacturers data.

A. TABLE 1

WIRE/POWDER DATA

TABLE 1: Wire/Powder Usage		
Wire/Powder Type	**Max Used lbs/hr**	**Max Used lbs/yr**
a.		
b.		
c.		

Wire/Powder Content			
Wire/Powder Constituents*	**Content %**		
	Wire #1	Wire #2	Wire #3
Iron			
Nickel			
Chrome			
Aluminum			
Copper			
Silicon			
_____			
_____			
_____			

* List constituents and percent content for each constituent based on manufacturer data.

NOTE: If the metal spraying process uses a gas, i.e. acetylene to produce the flame to melt the spray wire/powder or if an inert gas is used to propel the molten metal, identify the gas(es) used and the gas usage rates (cf/hr and cf/yr). The reviewing engineer will use this information to determine if emissions from these gases need to be included in the permit.

B. TABLE 2: EMISSION CALCULATIONS

Emissions from metal spraying operations must be determined. Operating parameters that influence emissions are gun spray rate, gun spray time, number of guns used, powder/wire type, spray environment, i.e. in a booth versus not in a booth, and type abatement equipment used.

Two methods for calculating emissions are provided. Either method will be accepted.

Method # 1 is based on spray deposit efficiency and assumes all material not deposited has a potential to be emitted. If Method #1 is used to calculate emissions, use equation 2a from Table # 2 to calculate Line 6, E1-PM10 Uncontrolled.

Method # 2 employs an emission factor expressed as pounds of emissions per pound of powder or wire sprayed. If Method # 2 is used to calculate emissions, use equation 2b from Table # 2 to calculate Line #6, E1-PM10 Uncontrolled.

The following parameters will be used to calculate emissions:

Line #	Parameter	Booth1	Booth2
1.	SG = Number of spray guns used at one time?	_____	_____
2.	SR = Gun spray rate (lbs/hr) for each powder/wire?	_____	_____
3.	TH = Maximum spray time per hour (min/hr)?		
	Wire 1	_____	_____
	Wire 2	_____	_____
4.	TY = Max spray time per year (Hrs./Yr)?		
	Wire 1	_____	_____
	Wire 2	_____	_____
5.	DF = Deposit factor (%)?		
	Wire 1	_____	_____
	Wire 2	_____	_____
6.	EF = Emission Factor (lbs emissions/lb wire sprayed)	0.06*****	0.06*****
7.	HE = Hood Capture Efficiency?	_____	_____
8.	AE = Control Device Efficiency?	_____	_____

***** 0.06 is a conservative estimate. If an emission factor exists which is deemed to be more accurate than the one provided, the applicant may use it provided that proper justification for the factor is given.

STEP 1: *Uncontrolled PM_{10} Calculation*

Calculate the uncontrolled PM_{10} emissions for each source and for each powder/wire sprayed. A source may be one gun or multiple guns operating simultaneously in one spray booth/chamber.

Use Equation 2a if the "deposit efficiency" method is used.

Use Equation 2b if the "emission factor" method is used.

Equation 2c for calculating annual emissions may be used with either method.

E1= SR x TH/60 x [1-(DF%/100)] (Equation 2a)

E1= SR X TH/60 X 0.06 (Equation 2b)

E2 = E1 x TY (Equation 2c)

STEP 2: *Open Area Spraying Calculations*

If metal spraying is conducted in an enclosed spray booth/chamber, go to Step 3. If spraying is conducted in an open/non enclosed area and a hood is used to capture emissions, then fugitive emissions and emissions captured must be determined.

FUG1= E1 x [1-(HE%/100)]; FUG1 is hourly fugitive PM_{10} emissions

FUG2 =E2 x [1-(HE%/100)]; FUG2 is annual fugitive PM_{10} emissions

E3= E1 x [HE%/100]; E3 is hourly PM_{10} emissions captured by the hood

E4= E2 x [HE%/100]; E4 is annual PM_{10} emissions captured by the hood

E5 = E3 x [1-(AE%/100)]; E5 is hourly PM_{10} emissions from control equipment

E6 = E4 x [1-(AE%/100)]; E6 is annual PM_{10} emissions from control equipment

STEP 3: *Spray Booth Calculation*

When metal spraying is conducted inside an enclosed booth/chamber with emissions exhausted to an abatement device, use the following equations to calculate the PM_{10} emitted to the atmosphere.

E5 = E1 x [1-(AE%/100)]

E6 = E2 x [1-(AE%/100)]

Note: E5 and E6 must be calculated for each spray booth and for each powder/wire sprayed. The total hourly emissions from each booth will be the E5 for the worst case hourly spray rate. The annual emissions from each booth will be the sum of the E6's for each powder/wire sprayed.

Step 4: *Speciated Emission Calculations.*

Speciated emissions must be determined for each constituent contained in the powder/wire sprayed.

Speciated emissions for each constituent are estimated to be the product of the fraction of the compound contained in the powder and the total PM_{10} emissions for the specific wire.

SEH(I) = E5 x (I %)/100 ; where SEH(I) is the hourly emission rate in pounds for compound (I).

SEY(I) = E6 x (I %)/100; where SEY(I) is the annual emissions in tons for compound (I)

C. TABLE 3: CONTROLLED EMISSIONS

E1 = Total Uncontrolled PM_{10} (lb/hr) (See Table 2). _____

E2 = Total Uncontrolled PM_{10} (lb/yr) (See Table 2). _____

E5 = Total PM_{10} (lb/hr) Controlled. _____

E6 = Total PM_{10} (lb/yr) Controlled. _____

E7 = Fugitive PM_{10} (lb/hr). ** _____

E8 = Fugitive PM_{10} (lb/yr). ** _____

****** If metal spraying is conducted in a spray booth with a negative pressure, this calculation is not required.

D. TABLE 4: SPECIATED EMISSIONS

Hourly emissions, SEH(xi) and annual emissions, SEY(xi) for each constituent of the powder or wire used must be quantified as described in STEP 4 and recorded.

SEH (x1) = _____ SEH (x1) = _____

SEY (x2) = _____ SEY (x2) = _____

METAL SPRAYING FACILITY EXAMPLE CALCULATIONS

NOTE: The applicant should complete these forms for maximum operating conditions and actual equipment specifications for the facility. For deposit efficiency and control device efficiency, refer to the manufacturers data.

A. TABLE 1

WIRE/POWDER DATA

TABLE 1: Wire/Powder Usage		
Wire/Powder Type	**Max Used lbs/hr**	**Max Used lbs/yr**
a. MONEL	**0**	**0**
b. METCOLY #4	**0**	**0**
c. METCO #405	**10**	**5000**

Wire/Powder Content			
Wire/Powder Constituents*	**Content %**		
	Wire #1	Wire #2	Wire #3
Iron	1.5	66	0
Nickel	67	12	80
Chrome	0	17	0
Aluminum	0.1	0	20
Copper	30.1	0	0
Silicon	0.1	1	0
_____			
_____			
_____			

* List constituents and percent content for each constituent based on manufacturer data.

B. TABLE 2: EMISSION CALCULATIONS

Line #	Parameter	Booth1	Booth2
1.	SG = Number of spray guns used at one time?	**1**	
2.	SR = Gun spray rate (lbs/hr) for each powder/wire?	**10**	
3.	TH = Maximum spray time per hour (min/hr)?		
	Wire 1	**30**	
	Wire 2		
4.	TY = Max spray time per year (Hrs./Yr)?		
	Wire 1	**1,000**	
	Wire 2		
5.	DF = Deposit factor (%)?		
	Wire 1	**75%**	
	Wire 2		
6.	EF = Emission Factor (lbs emissions/lb wire sprayed)	**Not applicable in this example**	
7.	HE = Hood Capture Efficiency?	**Not applicable in this example**	
8.	AE = Control Device Efficiency?	**99.999%**	

STEP 1: Uncontrolled PM_{10} Emission Calculation

E1= 10.0 x 30/60 x [1-(75/100)] = 1.25 lbs/hr
E2 = 1.25 lbs/hr x 1,000 Hr/Yr = 1250 lbs/yr

STEP 2: Open Area Spraying Calculation (**Not Applicable This Example**)

STEP 3: Spray Booth Calculation

E5 = 1.25 x [1-(99.999/100)] =$1.25E^{-5}$ lbs/Hr
E6 = 1250 x [1-(99.999/100)] =0.0125 lbs/Yr.

STEP 4: Speciated Emission Calculation

SEH(Ni) = 0.0000125 x 0.80 = 0.00001 lb/hr

SEY (Ni) = 0.0125 x 0.80 = 0.01 lb/yr

SEH(Al) = 0.0000125 x 0.20 = 0.0000025 lb/hr

SEY(Al) = 0.0125 x 0.20 0.0025 lb/yr

C. TABLE 3: CONTROLLED EMISSIONS

E1 = Total Uncontrolled PM_{10} (lb/hr) 1.25 lb/hr

E2 = Total Uncontrolled PM_{10} (lb/yr) 1250 lbs/yr

E5 = Total PM_{10} (lb/hr) Controlled. $1.25\ E^{-5}$ lbs/hr

E6 = Total PM_{10} (lb/yr) Controlled. 0.0125 tons/yr

Note: In this example, metal spraying is conducted in a BOOTH, thus calculation of fugitive emissions, i.e. E7 and E8 is not required.

D. TABLE 4: SPECIATED EMISSIONS

SEH (Ni)	0.00001	lbs/hr
SEY (Ni)	0.01	lbs/yr
SEH (Al)	0.0000025	lbs/hr
SEY (Al)	0.0025	lbs/yr