

APPENDIX B.1

PARTICLE SIZE DISTRIBUTION DATA AND  
SIZED EMISSION FACTORS FOR SELECTED SOURCES



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## APPENDIX B.1

### PARTICLE SIZE DISTRIBUTION DATA AND SIZED EMISSION FACTORS FOR SELECTED SOURCES

#### Introduction

This appendix presents particle size distributions and emission factors for miscellaneous sources or processes for which documented emission data were available. Generally, the sources of data used to develop particle size distributions and emission factors for this appendix were:

1. Source test reports in the files of the Emissions Monitoring, and Analysis Division of EPA's Office Of Air Quality Planning And Standards.
2. Source test reports in the Fine Particle Emission Information System (FPEIS), a computerized data base maintained by EPA's Air And Energy Engineering Research Laboratory, Office Of Research And Development.
3. A series of source tests titled *Fine Particle Emissions From Stationary And Miscellaneous Sources In The South Coast Air Basin*, by H. J. Taback.
4. Particle size distribution data reported in the literature by various individuals and companies.

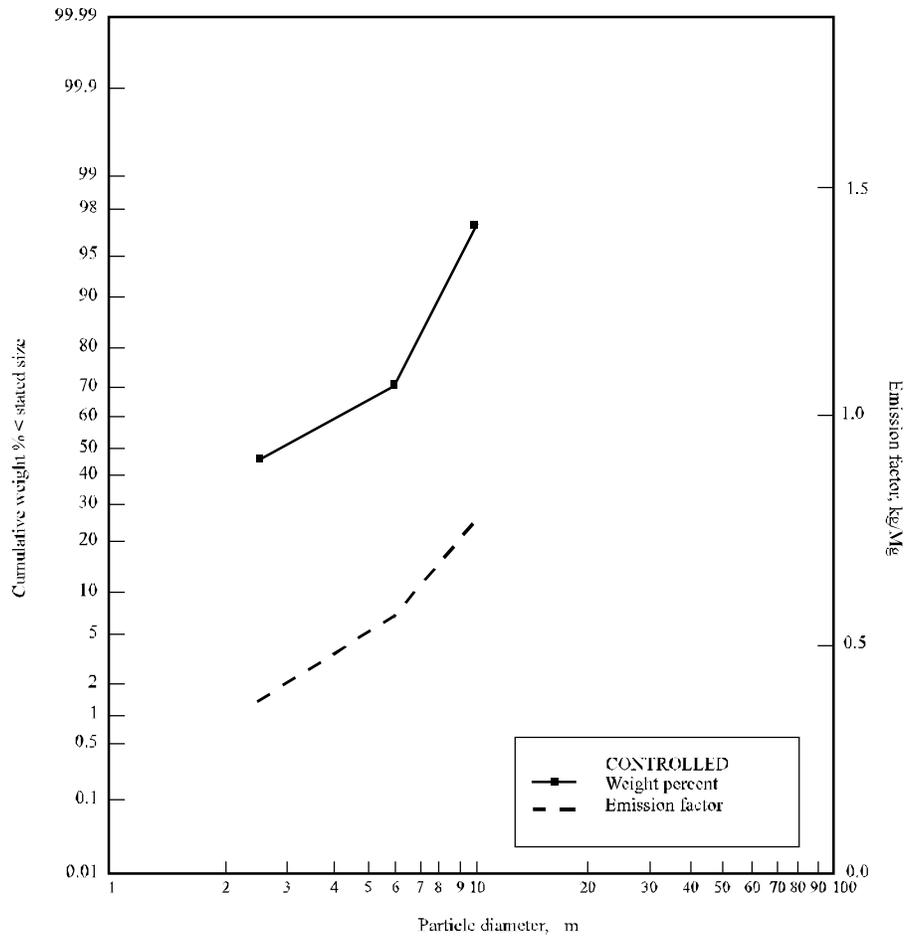
Particle size data from FPEIS were mathematically normalized into more uniform and consistent data. Where EMB tests and Taback report data were filed in FPEIS, the normalized data were used in developing this appendix.

Information on each source category in Appendix B.1 is presented in a 2-page format: For a source category, a graph provided on the first page presents a particle size distribution expressed as the cumulative weight percent of particles less than a specified aerodynamic diameter (cut point), in micrometers. A sized emission factor can be derived from the mathematical product of a mass emission factor and the cumulative weight percent of particles smaller than a specific cut point in the graph. At the bottom of the page is a table of numerical values for particle size distributions and sized emission factors, in micrometers, at selected values of aerodynamic particle diameter. The second page gives some information on the data used to derive the particle size distributions.

Portions of the appendix denoted TBA in the table of contents refer to information that will be added at a later date.

## 1.8 BAGASSE-FIRED BOILER: EXTERNAL COMBUSTION

1.8 BAGASSE-FIRED BOILER: EXTERNAL COMBUSTION



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Wet scrubber controlled	Wet scrubber controlled
2.5	46.3	0.37
6.0	70.5	0.56
10.0	97.1	0.78

## 1.8 BAGASSE-FIRED BOILER: EXTERNAL COMBUSTION

NUMBER OF TESTS: 2, conducted after wet scrubber control

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	46.3	70.5	97.1
	Standard deviation (Cum. %):	0.9	0.9	1.9
	Min (Cum. %):	45.4	69.6	95.2
	Max (Cum. %):	47.2	71.4	99.0

TOTAL PARTICULATE EMISSION FACTOR: Approximately 0.8 kg particulate/Mg bagasse charged to boiler. This factor is derived from AP-42, Section 1.8, 4/77, which states that the particulate emission factor from an uncontrolled bagasse-fired boiler is 8 kg/Mg and that wet scrubbers typically provide 90% particulate control.

SOURCE OPERATION: Source is a Riley Stoker Corp. vibrating grate spreader stoker boiler rated at 120,000 lb/hr but operated during this testing at 121% of rating. Average steam temperature and pressure were 579°F and 199 psig, respectively. Bagasse feed rate could not be measured, but was estimated to be about 41 (wet) tons/hr.

SAMPLING TECHNIQUE: Andersen Cascade Impactor

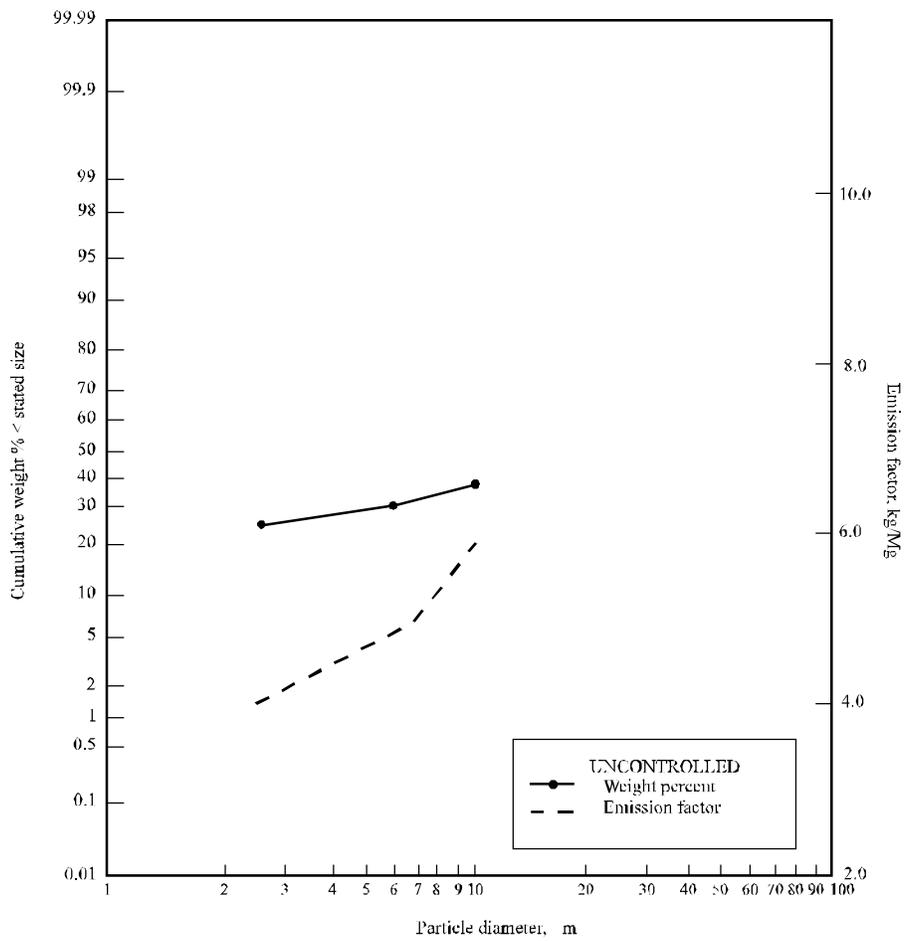
EMISSION FACTOR RATING: D

REFERENCE:

*Emission Test Report, U. S. Sugar Company, Bryant, FL, EMB-80-WFB-6, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.*

## 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MASS BURN INCINERATOR

### 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MASS BURN INCINERATOR



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled		Uncontrolled
2.5	26.0		3.9
6.0	30.6		4.6
10.0	38.0		5.7

## 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MASS BURN INCINERATOR

NUMBER OF TESTS: 7, conducted before control

STATISTICS:	Aerodynamic Particle Diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	26.0	30.6	38.0
	Standard deviation (Cum. %):	9.5	13.0	14.0
	Min (Cum. %):	18	22	24
	Max (Cum. %):	40	49	54

TOTAL PARTICULATE EMISSION FACTOR: 15 kg of particulate/Mg of refuse charged. Emission factor from AP-42 Section 2.1.

SOURCE OPERATION: Municipal incinerators reflected in the data base include various mass burning facilities of typical design and operation.

SAMPLING TECHNIQUE: Unknown

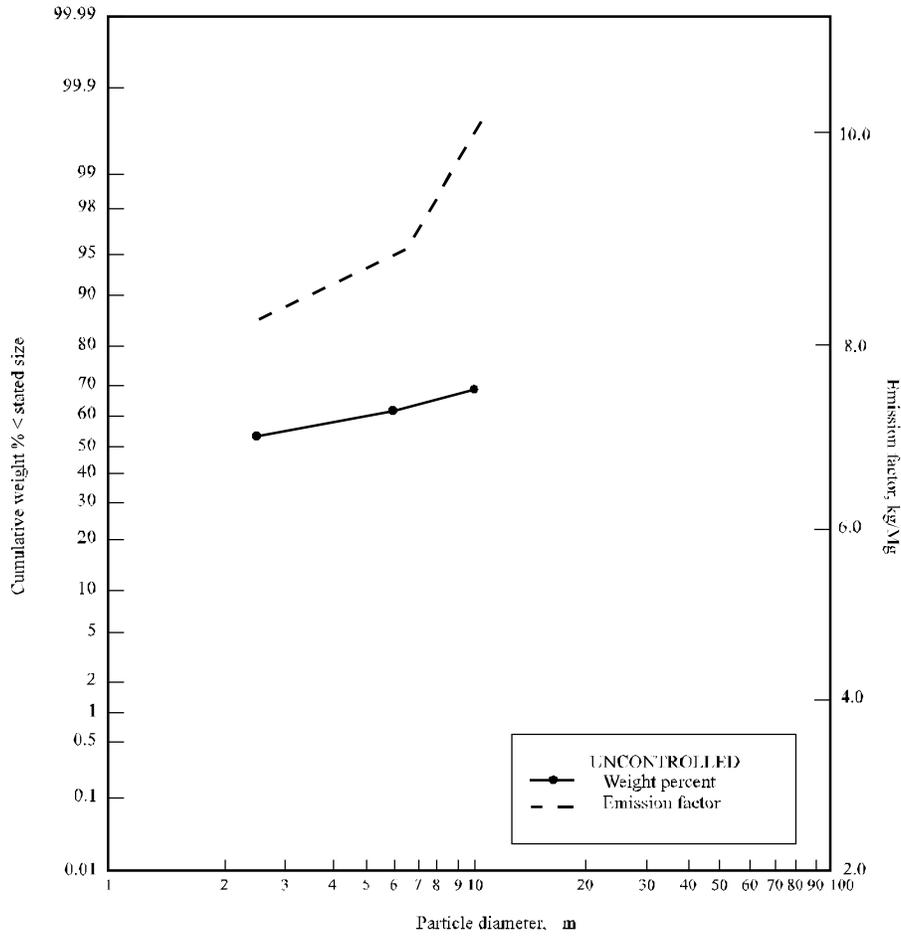
EMISSION FACTOR RATING: D

REFERENCE:

*Determination of Uncontrolled Emissions, Product 2B, Montgomery County, Maryland, Roy F. Weston, Inc., West Chester, PA, August 1984.*

## 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MODULAR INCINERATOR

### 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MODULAR INCINERATOR



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	54.0		8.1	
6.0	60.1		9.0	
10.0	67.1		10.1	

## 2.1 REFUSE INCINERATION: MUNICIPAL WASTE MODULAR INCINERATOR

NUMBER OF TESTS: 3, conducted before control

STATISTICS:	Aerodynamic Particle Diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	54.0	60.1	67.1
	Standard deviation (Cum. %):	19.0	20.8	23.2
	Min (Cum. %):	34.5	35.9	37.5
	Max (Cum. %):	79.9	86.6	94.2

TOTAL PARTICULATE EMISSION FACTOR: 15 kg of particulate/Mg of refuse charged. Emission factor from AP-42 Section 2.1.

SOURCE OPERATION: Modular incinerator (2-chambered) operation was at 75.9% of the design process rate (10,000 lb/hr) and 101.2% of normal steam production rate. Natural gas is required to start the incinerator each week. Average waste charge rate was 1.983T/hr. Net heating value of garbage 4200-4800 Btu/lb garbage charged.

SAMPLING TECHNIQUE: Andersen Impactor

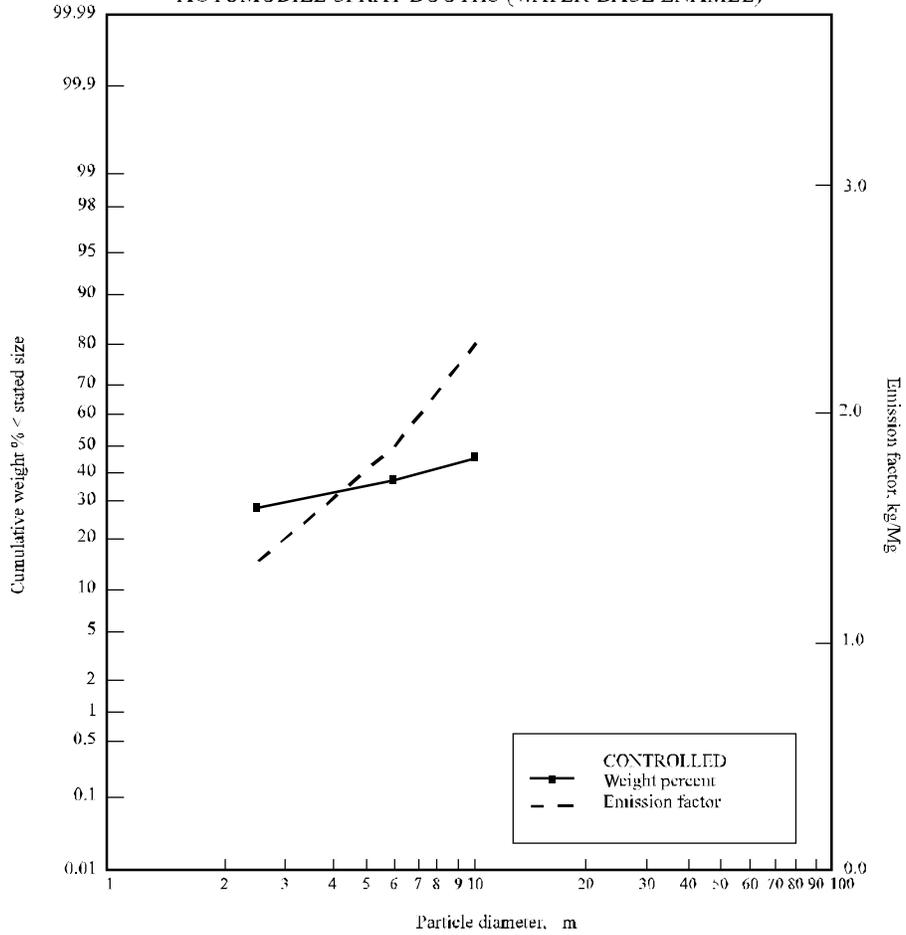
EMISSION FACTOR RATING: C

REFERENCE:

*Emission Test Report, City of Salem, Salem, Va, EMB-80-WFB-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1980.*

4.2.2.8 AUTOMOBILE AND LIGHT-DUTY TRUCK SURFACE COATING OPERATIONS:  
AUTOMOBILE SPRAY BOOTHS (WATER-BASE ENAMEL)

4.2.2.8 AUTOMOBILE AND LIGHT-DUTY TRUCK SURFACE COATING OPERATIONS:  
AUTOMOBILE SPRAY BOOTHS (WATER-BASE ENAMEL)



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Water curtain controlled	Water curtain controlled
2.5	28.6	1.39
6.0	38.2	1.85
10.0	46.7	2.26

4.2.2.8 AUTOMOBILE AND LIGHT-DUTY TRUCK SURFACE COATING OPERATIONS:  
AUTOMOBILE SPRAY BOOTHS (WATER-BASE ENAMEL)

NUMBER OF TESTS: 2, conducted after water curtain control

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	28.6	38.2	46.7
	Standard deviation (Cum. %):	14.0	16.8	20.6
	Min (Cum. %):	15.0	21.4	26.1
	Max (Cum. %):	42.2	54.9	67.2

TOTAL PARTICULATE EMISSION FACTOR: 4.84 kg particulate/Mg of water-base enamel sprayed. From References a and b.

SOURCE OPERATION: Source is a water-base enamel spray booth in an automotive assembly plant. Enamel spray rate is 568 lb/hour, but spray gun type is not identified. The spray booth exhaust rate is 95,000 scfm. Water flow rate to the water curtain control device is 7181 gal/min. Source is operating at 84% of design rate.

SAMPLING TECHNIQUE: SASS and Joy trains with cyclones

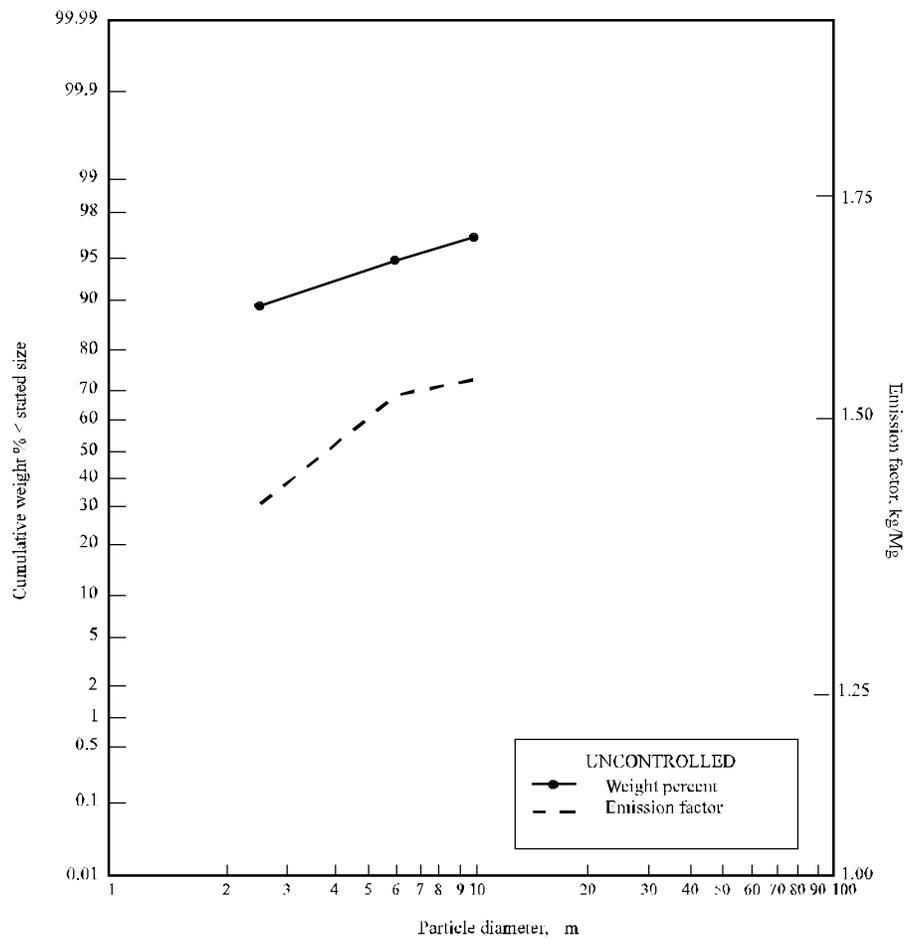
EMISSION FACTOR RATING: D

REFERENCES:

- a. H. J. Taback, *Fine Particle Emissions from Stationary and Miscellaneous Sources in the South Coast Air Basin*, PB 293 923/AS, National Technical Information Service, Springfield, VA, February 1979.
- b. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 234, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

## 6.1 CARBON BLACK: OIL FURNACE PROCESS OFFGAS BOILER

6.1 CARBON BLACK: OIL FURNACE PROCESS OFFGAS BOILER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled		Uncontrolled
2.5	87.3		1.40
6.0	95.0		1.52
10.0	97.0		1.55

## 6.1 CARBON BLACK: OIL FURNACE PROCESS OFFGAS BOILER

NUMBER OF TESTS: 3, conducted at offgas boiler outlet

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	87.3	95.0	97.0
	Standard Deviation (Cum. %):	2.3	3.7	8.0
	Min (Cum. %):	76.0	90.0	94.5
	Max (Cum. %):	94.0	99	100

TOTAL PARTICULATE EMISSION FACTOR: 1.6 kg particulate/Mg carbon black produced, from reference.

SOURCE OPERATION: Process operation: "normal" (production rate = 1900 kg/hr). Product is collected in fabric filter, but the offgas boiler outlet is uncontrolled.

SAMPLING TECHNIQUE: Brink Cascade Impactor

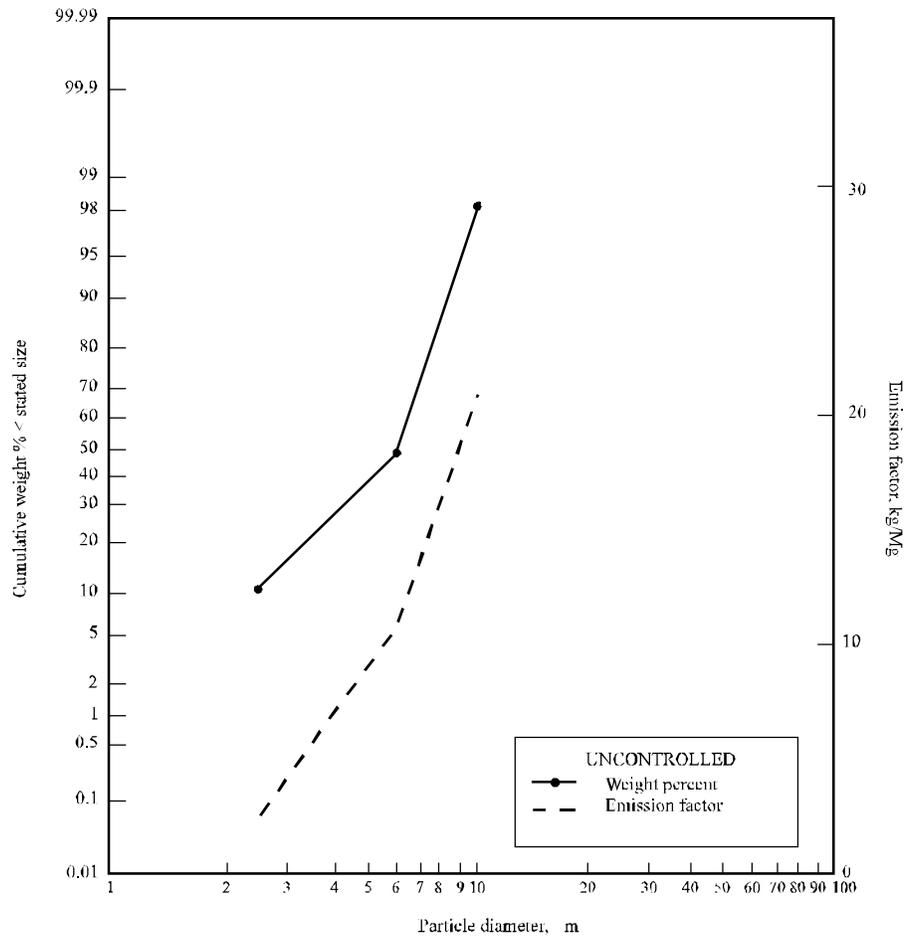
EMISSION FACTOR RATING: D

REFERENCE:

*Air Pollution Emission Test, Phillips Petroleum Company, Toledo, OH, EMB-73-CBK-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1974.*

## 8.4 AMMONIUM SULFATE FERTILIZER: ROTARY DRYER

### 8.4 AMMONIUM SULFATE FERTILIZER: ROTARY DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled		Uncontrolled
2.5	10.8		2.5
6.0	49.1		11.3
10.0	98.6		22.7

#### 8.4 AMMONIUM SULFATE FERTILIZER: ROTARY DRYER

NUMBER OF TESTS: 3, conducted before control

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	10.8	49.1	98.6
Standard Deviation (Cum. %):	5.1	21.5	1.8
Min (Cum. %):	4.5	20.3	96.0
Max (Cum. %):	17.0	72.0	100.0

TOTAL PARTICULATE EMISSION FACTOR: 23 kg particulate/Mg of ammonium sulfate produced. Factor from AP-42, Section 8.4.

SOURCE OPERATION: Testing was conducted at 3 ammonium sulfate plants operating rotary dryers within the following production parameters:

Plant	A	C	D
% of design process rate	100.6	40.1	100
production rate, Mg/hr	16.4	6.09	8.4

SAMPLING TECHNIQUE: Andersen Cascade Impactors

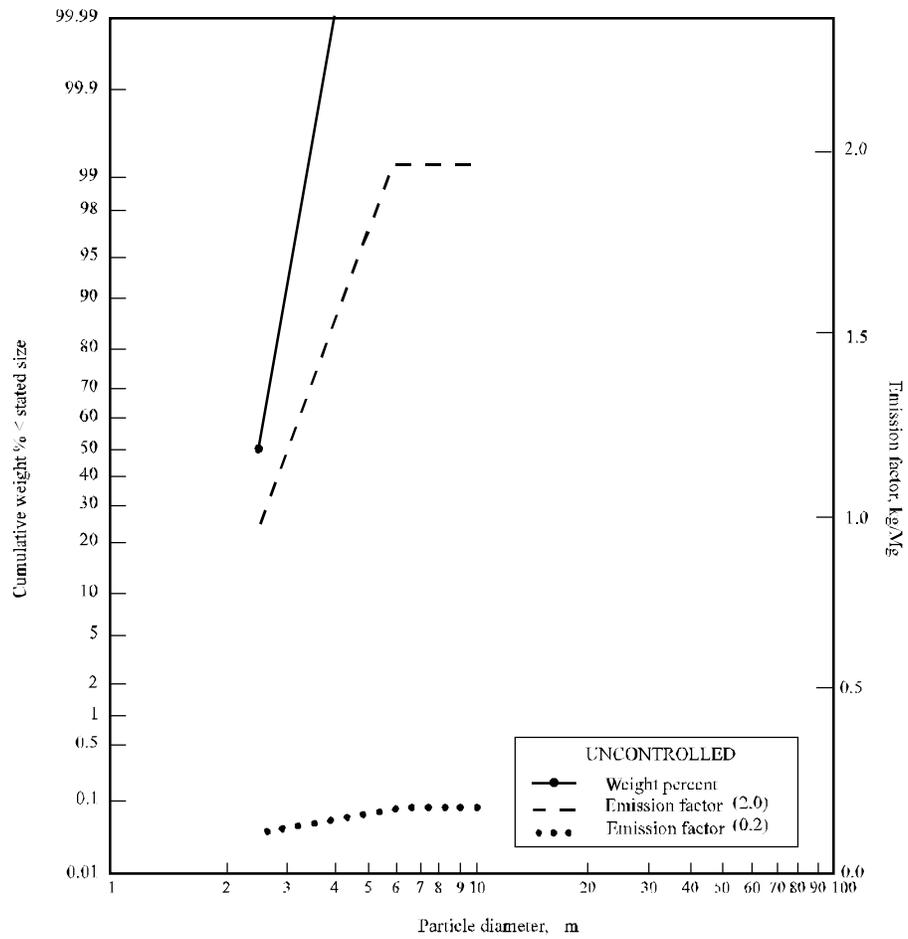
EMISSION FACTOR RATING: C

REFERENCE:

*Ammonium Sulfate Manufacture — Background Information For Proposed Emission Standards*, EPA-450/3-79-034a, U. S. Environmental Protection Agency, Research Triangle Park, NC, December 1979.

## 8.10 SULFURIC ACID: ABSORBER (ACID ONLY)

8.10 SULFURIC ACID: ABSORBER (ACID ONLY)



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled	Uncontrolled	Uncontrolled	
			(0.2)	(2.0)
2.5	51.2	0.10	1.0	
6.0	100	0.20	2.0	
10.0	100	0.20	2.0	

## 8.10 SULFURIC ACID: ABSORBER (ACID ONLY)

NUMBER OF TESTS: Not available

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	51.2	100	100
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 0.2 to 2.0 kg acid mist/Mg sulfur charged, for uncontrolled 98% acid plants burning elemental sulfur. Emission factors are from AP-42 Section 8.10.

SOURCE OPERATION: Not available

SAMPLING TECHNIQUE: Brink Cascade Impactor

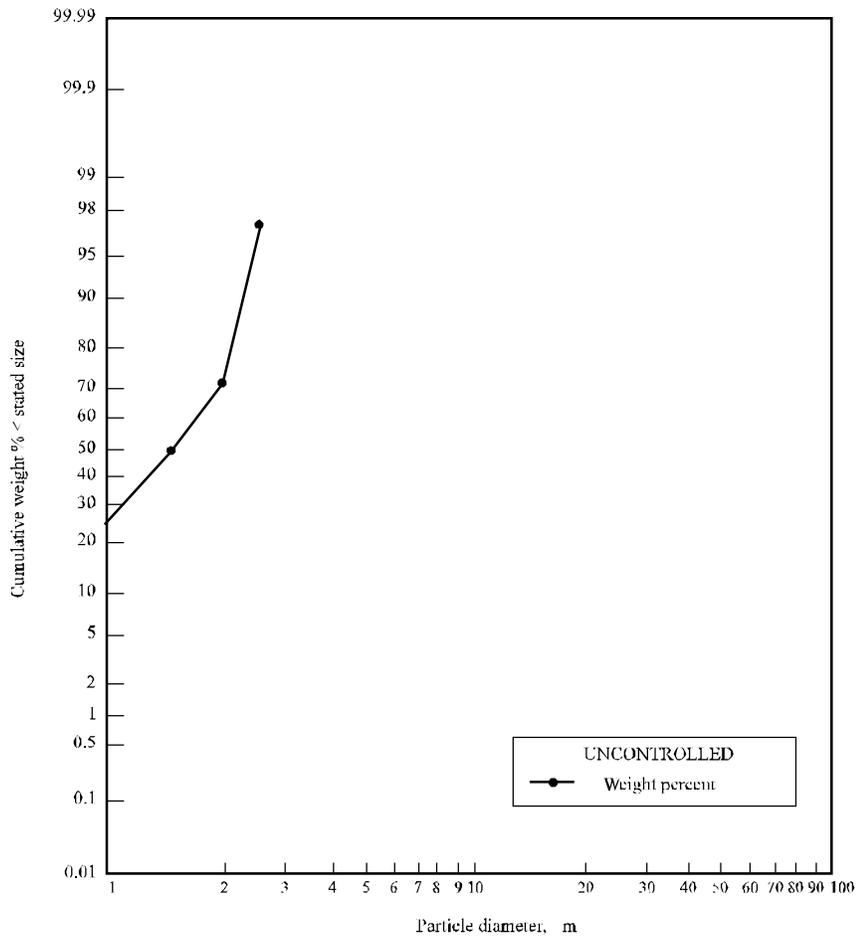
EMISSION FACTOR RATING: E

### REFERENCES:

- a. *Final Guideline Document: Control Of Sulfuric Acid Mist Emissions From Existing Sulfuric Acid Production Units*, EPA-450/2-77-019, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1977.
- b. R. W. Kurek, *Special Report On EPA Guidelines For State Emission Standards For Sulfuric Acid Plant Mist*, E. I. du Pont de Nemours and Company, Wilmington, DE, June 1974.
- c. J. A. Brink, Jr., "Cascade Impactor For Adiabatic Measurements", *Industrial and Engineering Chemistry*, 50:647, April 1958.

## 8.10 SULFURIC ACID: ABSORBER, 20% OLEUM

8.10 SULFURIC ACID: ABSORBER, 20% OLEUM



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled		Uncontrolled
2.5	97.5		See Table 8.10-2
6.0	100		
10.0	100		

## 8.10 SULFURIC ACID: ABSORBER, 20% OLEUM

NUMBER OF TESTS: Not available

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ )*:	1.0	1.5	2.0
	Mean (Cum. %):	26	50	73
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: Acid mist emissions from sulfuric acid plants are a function of type of feed as well as oleum content of product. See AP-42, Section 8.10, Tables 8.10-2 and 8.10-3.

SOURCE OPERATION: Not available

SAMPLING TECHNIQUE: Brink Cascade Impactor

EMISSION FACTOR RATING: E

### REFERENCES:

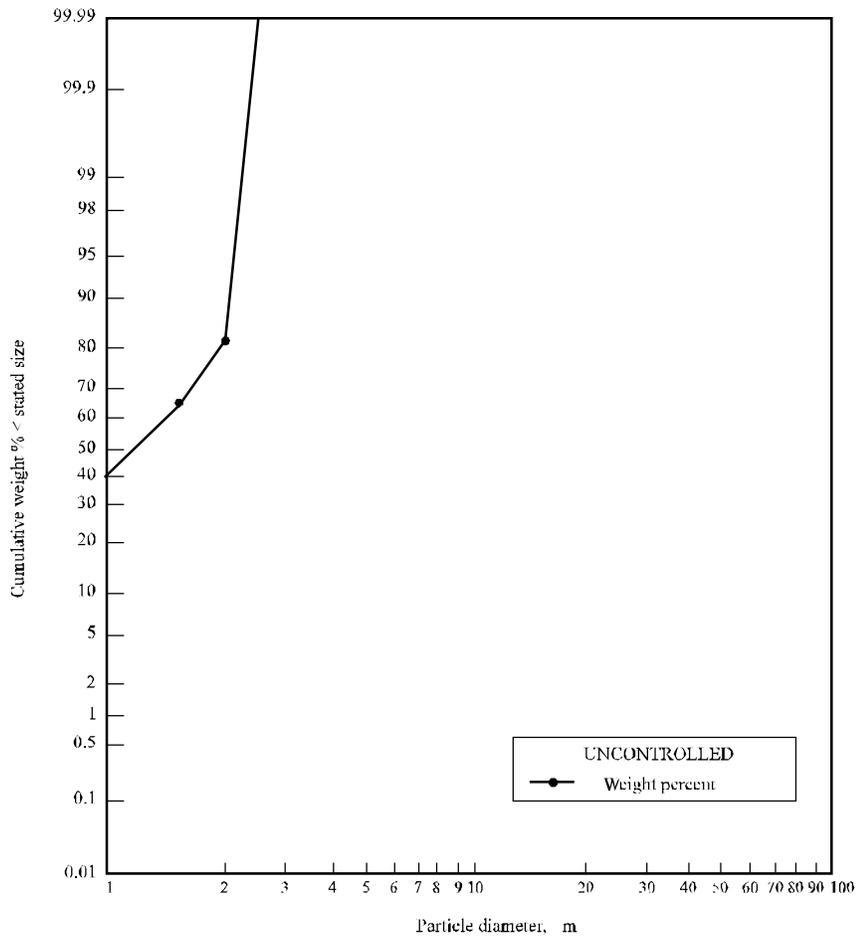
- a. *Final Guideline Document: Control Of Sulfuric Acid Mist Emissions From Existing Sulfuric Acid Production Units*, EPA-450/2-77-019, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1977.
- b. R. W. Kurek, *Special Report On EPA Guidelines For State Emission Standards For Sulfuric Acid Plant Mist*, E. I. du Pont de Nemours and Company, Wilmington, DE, June 1974.
- c. J. A. Brink, Jr., "Cascade Impactor For Adiabatic Measurements", *Industrial and Engineering Chemistry*, 50:647, April 1958.

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\*100% of the particulate is less than 2.5  $\mu\text{m}$  in diameter.

## 8.10 SULFURIC ACID: ABSORBER, 32% OLEUM

8.10 SULFURIC ACID: ABSORBER, 32% OLEUM



Aerodynamic particle diameter, $\mu$ m	Cumulative wt. % < stated size	
	Uncontrolled	Uncontrolled
2.5	100	See Table 8.10-2
6.0	100	
10.0	100	

## 8.10 SULFURIC ACID: ABSORBER, 32% OLEUM

NUMBER OF TESTS: Not available

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ )*:	1.0	1.5	2.0
	Mean (Cum. %):	41	63	84
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: Acid mist emissions from sulfuric acid plants are a function of type of feed as well as oleum content of product. See AP-42, Section 8.10, Table 8.10-2.

SOURCE OPERATION: Not available

SAMPLING TECHNIQUE: Brink Cascade Impactor

EMISSION FACTOR RATING: E

### REFERENCES:

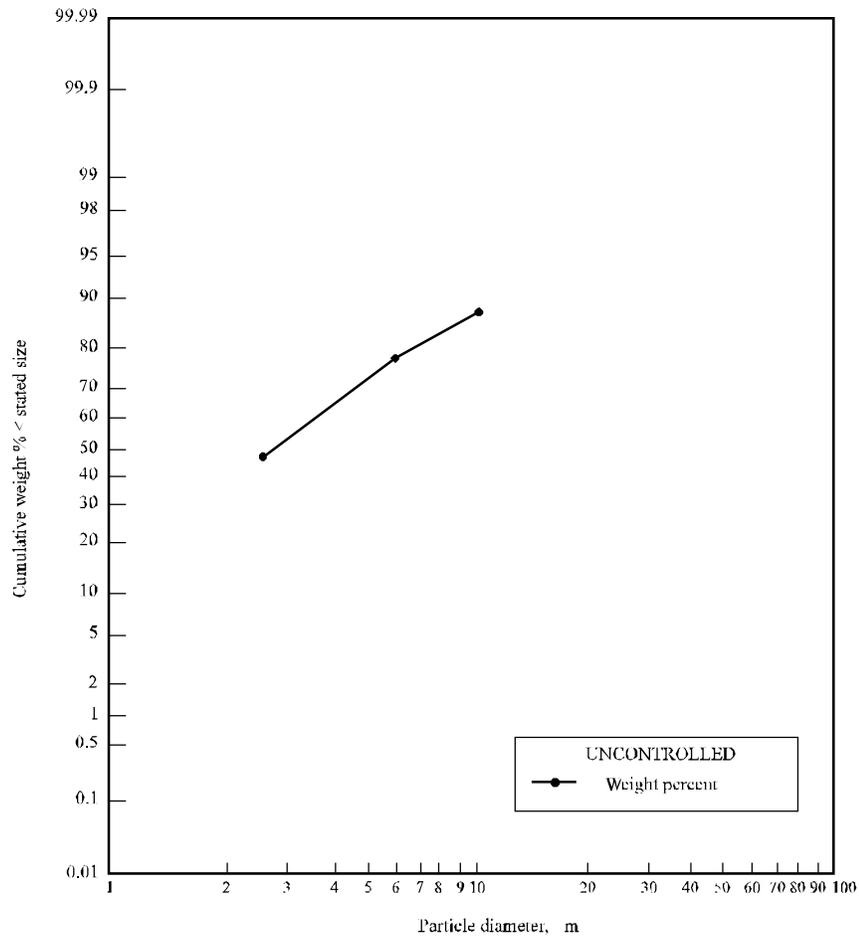
- a. *Final Guideline Document: Control Of Sulfuric Acid Mist Emissions From Existing Sulfuric Acid Production Units*, EPA-450/2-77-019, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1977.
- b. R. W. Kurek, *Special Report On EPA Guidelines For State Emission Standards For Sulfuric Acid Plant Mist*, E. I. du Pont de Nemours and Company, Wilmington, DE, June 1974.
- c. J. A. Brink, Jr., "Cascade Impactor For Adiabatic Measurements", *Industrial and Engineering Chemistry*, 50:647, April 1958.

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\*100% of the particulate is less than 2.5  $\mu\text{m}$  in diameter.

## 8.10 SULFURIC ACID: SECONDARY ABSORBER

### 8.10 SULFURIC ACID: SECONDARY ABSORBER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Uncontrolled	Uncontrolled
2.5	48	Not Available
6.0	78	Not Available
10.0	87	Not Available

## 8.10 SULFURIC ACID: SECONDARY ABSORBER

NUMBER OF TESTS: Not available

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	48	78	87
	Standard Deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: Acid mist emission factors vary widely according to type of sulfur feedstock. See AP-42 Section 8.10 for guidance.

SOURCE OPERATION: Source is the second absorbing tower in a double absorption sulfuric acid plant. Acid mist loading is 175 - 350  $\text{mg}/\text{m}^3$ .

SAMPLING TECHNIQUE: Andersen Impactor

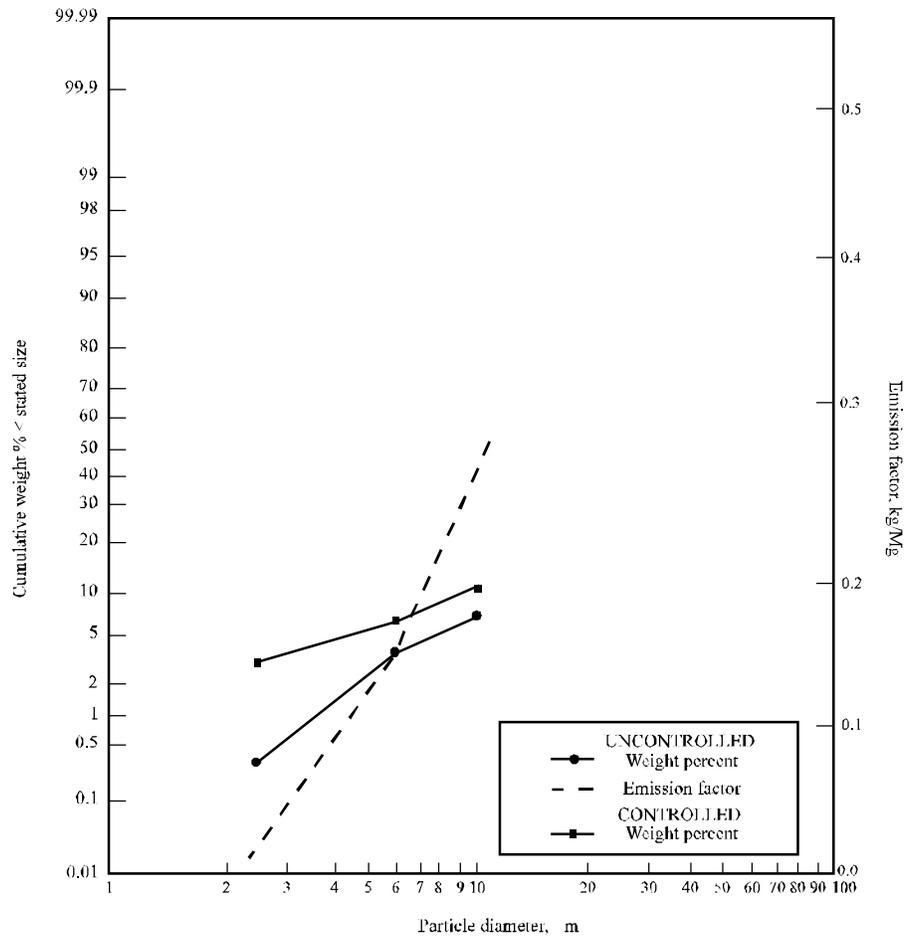
EMISSION FACTOR RATING: E

REFERENCE:

G. E. Harris and L. A. Rohlack, "Particulate Emissions From Non-fired Sources In Petroleum Refineries: A Review Of Existing Data", Publication No. 4363, American Petroleum Institute, Washington, DC, December 1982.

## 8.xx BORIC ACID DRYER

8.xx BORIC ACID DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled	Fabric filter	Uncontrolled	Fabric filter controlled
2.5	0.3	3.3	0.01	0.004
6.0	3.3	6.7	0.14	0.007
10.0	6.9	10.6	0.29	0.011

## 8.xx BORIC ACID DRYER

NUMBER OF TESTS: (a) 1, conducted before controls  
(b) 1, conducted after fabric filter control

STATISTICS: (a) Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	0.3	3.3	6.9
Standard Deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			
(b) Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	3.3	6.7	10.6
Standard Deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: Before control, 4.15 kg particulate/Mg boric acid dried. After fabric filter control, 0.11 kg particulate/Mg boric acid dried. Emission factors from Reference a.

SOURCE OPERATION: 100% of design process rate.

SAMPLING TECHNIQUE: (a) Joy train with cyclones  
(b) SASS train with cyclones

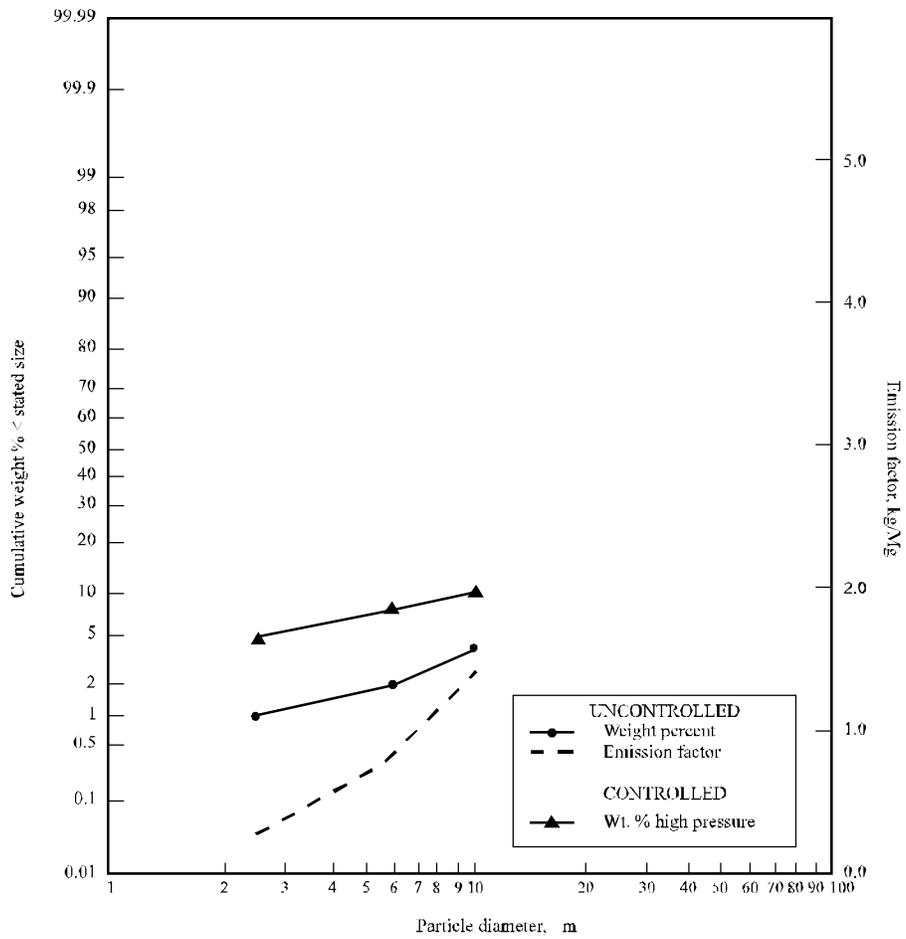
EMISSION FACTOR RATING: E

### REFERENCES:

- a. H. J. Taback, *Fine Particle Emissions From Stationary And Miscellaneous Sources In The South Coast Air Basin*, PB 293 923/AS, National Technical Information Service, Springfield, VA, February 1979.
- b. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 236, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

## 8.xx POTASH (POTASSIUM CHLORIDE) DRYER

### 8.xx POTASH (POTASSIUM CHLORIDE) DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled	High pressure drop venturi scrubber	Uncontrolled
2.5	0.95	5.0	0.31
6.0	2.46	7.5	0.81
10.0	4.07	9.0	1.34

8.xx POTASH (POTASSIUM CHLORIDE) DRYER

NUMBER OF TESTS: (a) 7, before control  
(b) 1, after cyclone and high pressure drop venturi scrubber control

STATISTICS:	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	0.95	2.46	4.07
	Standard deviation (Cum. %):	0.68	2.37	4.34
	Min (Cum. %):	0.22	0.65	1.20
	Max (Cum. %):	2.20	7.50	13.50

(b)	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	5.0	7.5	9.0
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: Uncontrolled emissions of 33 kg particulate/Mg of potassium chloride product from dryer, from AP-42. It is assumed that particulate emissions from rotary gas-fired dryers for potassium chloride are similar to particulate emissions from rotary steam tube dryers for sodium carbonate.

SOURCE OPERATION: Potassium chloride is dried in a rotary gas-fired dryer.

SAMPLING TECHNIQUE: (a) Andersen Impactor  
(b) Andersen Impactor

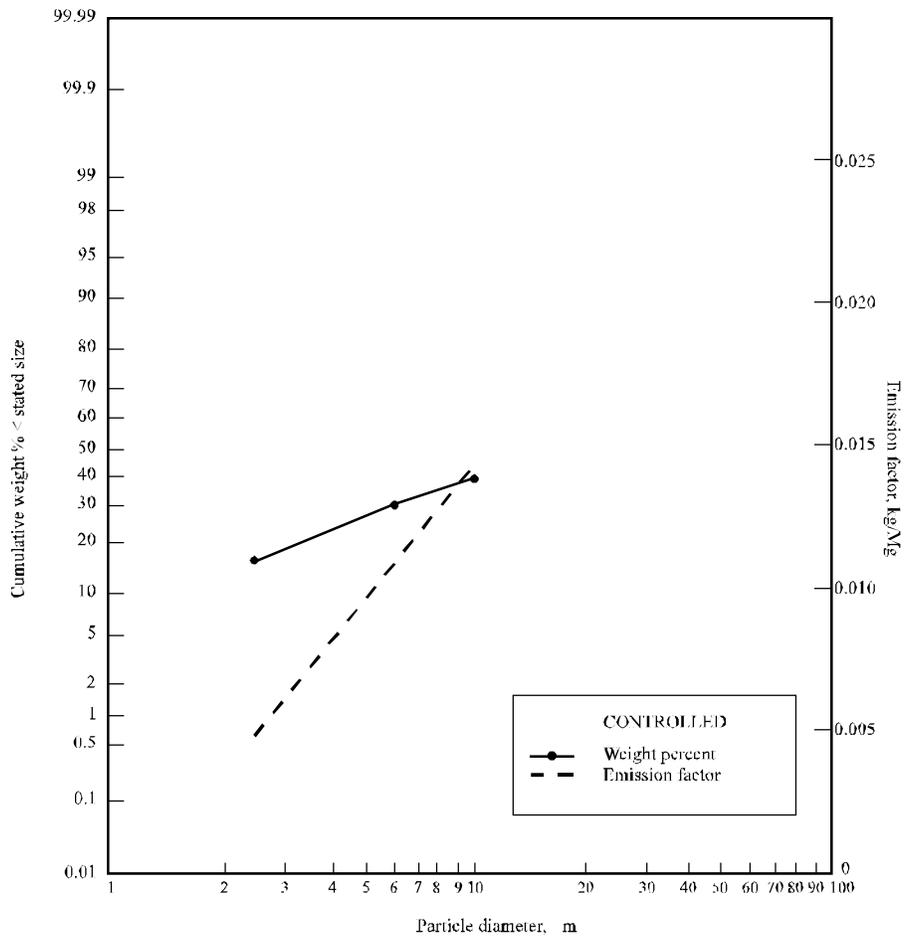
EMISSION FACTOR RATING: C

REFERENCES:

- a. *Emission Test Report, Kerr-Magee, Trona, CA, EMB-79-POT-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1979.*
- b. *Emission Test Report, Kerr-Magee, Trona, CA, EMB-79-POT-5, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1979.*

## 8.xx POTASH (POTASSIUM SULFATE) DRYER

8.xx POTASH (POTASSIUM SULFATE) DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Controlled with fabric filter		Controlled with fabric filter	
2.5	18.0		0.006	
6.0	32.0		0.011	
10.0	43.0		0.014	

## 8.xx POTASH (POTASSIUM SULFATE) DRYER

NUMBER OF TESTS: 2, conducted after fabric filter

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	18.0	32.0	43.0
Standard deviation (Cum. %):	7.5	11.5	14.0
Min (Cum. %):	10.5	21.0	29.0
Max (Cum. %):	24.5	44.0	14.0

TOTAL PARTICULATE EMISSION FACTOR: After fabric filter control, 0.033 kg of particulate per Mg of potassium sulfate product from the dryer. Calculated from an uncontrolled emission factor of 33 kg/Mg and control efficiency of 99.9%. From Reference a and AP-42, Section 8.12. It is assumed that particulate emissions from rotary gas-fired dryers are similar to those from rotary steam tube dryers.

SOURCE OPERATION: Potassium sulfate is dried in a rotary gas-fired dryer.

SAMPLING TECHNIQUE: Andersen Impactor

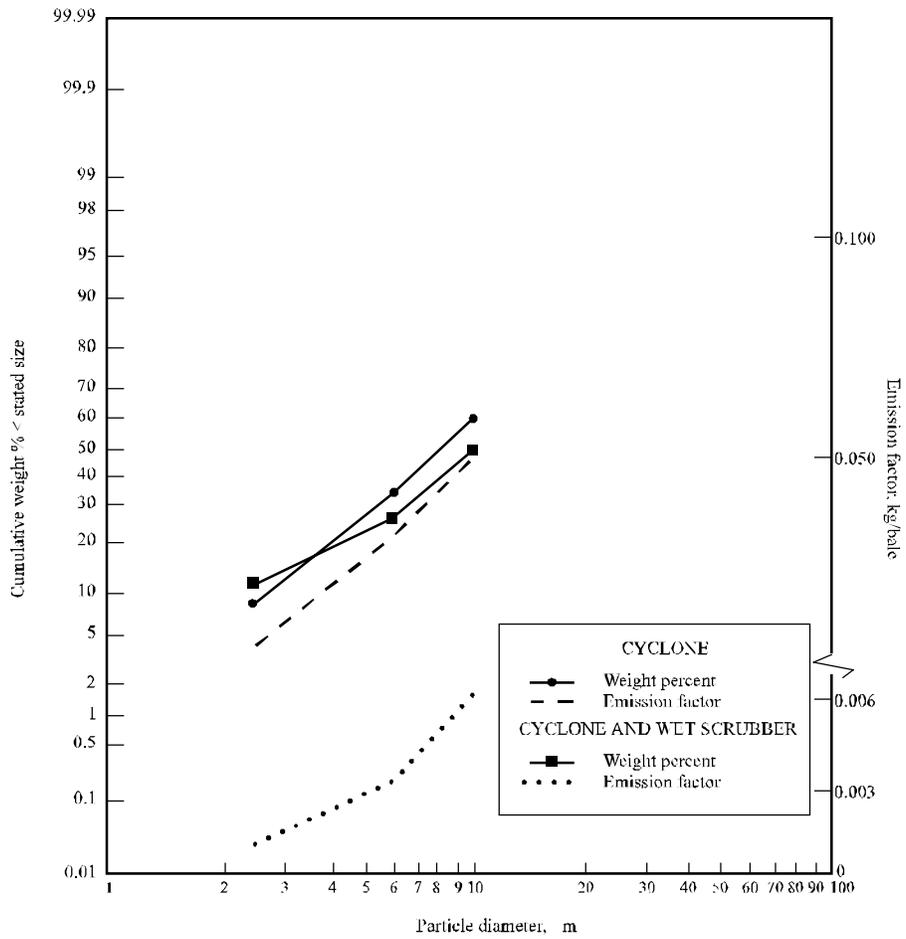
EMISSION FACTOR RATING: E

### REFERENCES:

- a. *Emission Test Report, Kerr-McGee, Trona, CA*, EMB-79-POT-4, Office Of Air Quality Planning And Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1979.
- b. *Emission Test Report, Kerr-McGee, Trona, CA*, EMB-79-POT-5, Office Of Air Quality Planning And Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1979.

## 9.7 COTTON GINNING: BATTERY CONDENSER

9.7 COTTON GINNING: BATTERY CONDENSER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/bale	
	With cyclone	With cyclone & wet scrubber	With cyclone	With cyclone & wet scrubber
2.5	8	11	0.007	0.001
6.0	33	26	0.028	0.003
10.0	62	52	0.053	0.006

## 9.7 COTTON GINNING: BATTERY CONDENSER

NUMBER OF TESTS: (a) 2, after cyclone  
(b) 3, after wet scrubber

STATISTICS: (a) Aerodynamic particle diameter ( $\mu\text{m}$ ): 2.5 6.0 10.0  
Mean (Cum. %): 8 33 62  
Standard deviation (Cum. %):  
Min (Cum. %):  
Max (Cum. %):

(b) Aerodynamic particle diameter ( $\mu\text{m}$ )  
Mean (Cum. %): 11 26 52  
Standard deviation (Cum. %):  
Min (Cum. %):  
Max (Cum. %):

TOTAL PARTICULATE EMISSION FACTOR: Particulate emission factor for battery condensers with typical controls is 0.09 kg (0.19 lb)/bale of cotton. Factor is from AP-42, Section 9.7. Factor with wet scrubber after cyclone is 0.012 kg (0.026 lb)/bale. Scrubber efficiency is 86%. From Reference b.

SOURCE OPERATION: During tests, source was operating at 100% of design capacity. No other information on source is available.

SAMPLING TECHNIQUE: UW Mark 3 Impactor

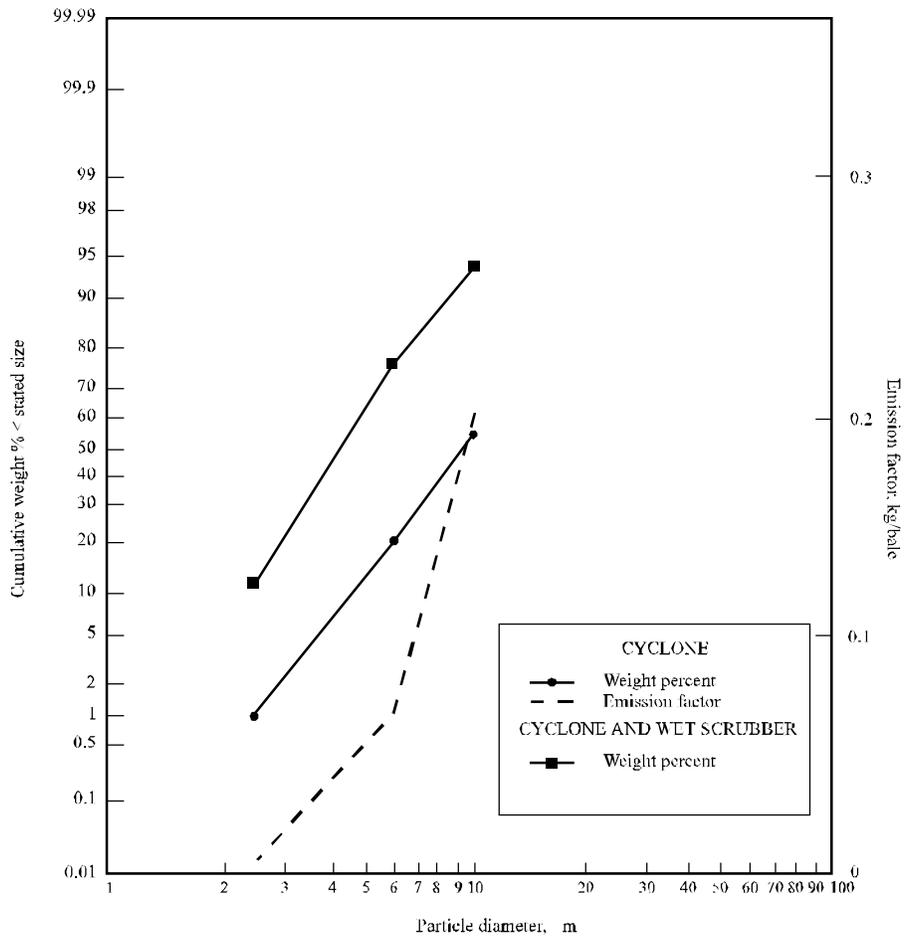
EMISSION FACTOR RATING: E

### REFERENCES:

- a. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System (FPEIS), Series Report No. 27, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.
- b. Robert E. Lee, Jr., *et al.*, "Concentration And Size Of Trace Metal Emissions From A Power Plant, A Steel Plant, And A Cotton Gin", *Environmental Science And Technology*, 9(7)643-7, July 1975.

## 9.7 COTTON GINNING: LINT CLEANER AIR EXHAUST

9.7 COTTON GINNING: LINT CLEANER AIR EXHAUST



Aerodynamic particle diameter, $\mu$ m	Cumulative wt. % < stated size		Emission factor, kg/bale
	After cyclone	After cyclone & wet scrubber	Controlled with fabric filter
2.5	1	11	0.004
6.0	20	74	0.07
10.0	54	92	0.20

9.7 COTTON GINNING: LINT CLEANER AIR EXHAUST

NUMBER OF TESTS: (a) 4, after cyclone  
(b) 4, after cyclone and wet scrubber

STATISTICS: (a) Aerodynamic particle diameter ( $\mu\text{m}$ ):           2.5     6.0     10.0  
Mean (Cum. %):   1     20     54  
Standard deviation (Cum. %):  
Min (Cum. %):  
Max (Cum. %):

(b) Aerodynamic particle diameter ( $\mu\text{m}$ ):           2.5     6.0     10.0  
Mean (Cum. %):   11     74     92  
Standard deviation (Cum. %):  
Min (Cum. %):  
Max (Cum. %):

TOTAL PARTICULATE EMISSION FACTOR: 0.37 kg particulate/bale of cotton processed, with typical controls. Factor is from AP-42, Section 9.7.

SOURCE OPERATION: Testing was conducted while processing both machine-picked and ground-harvested upland cotton, at a production rate of about 6.8 bales/hr.

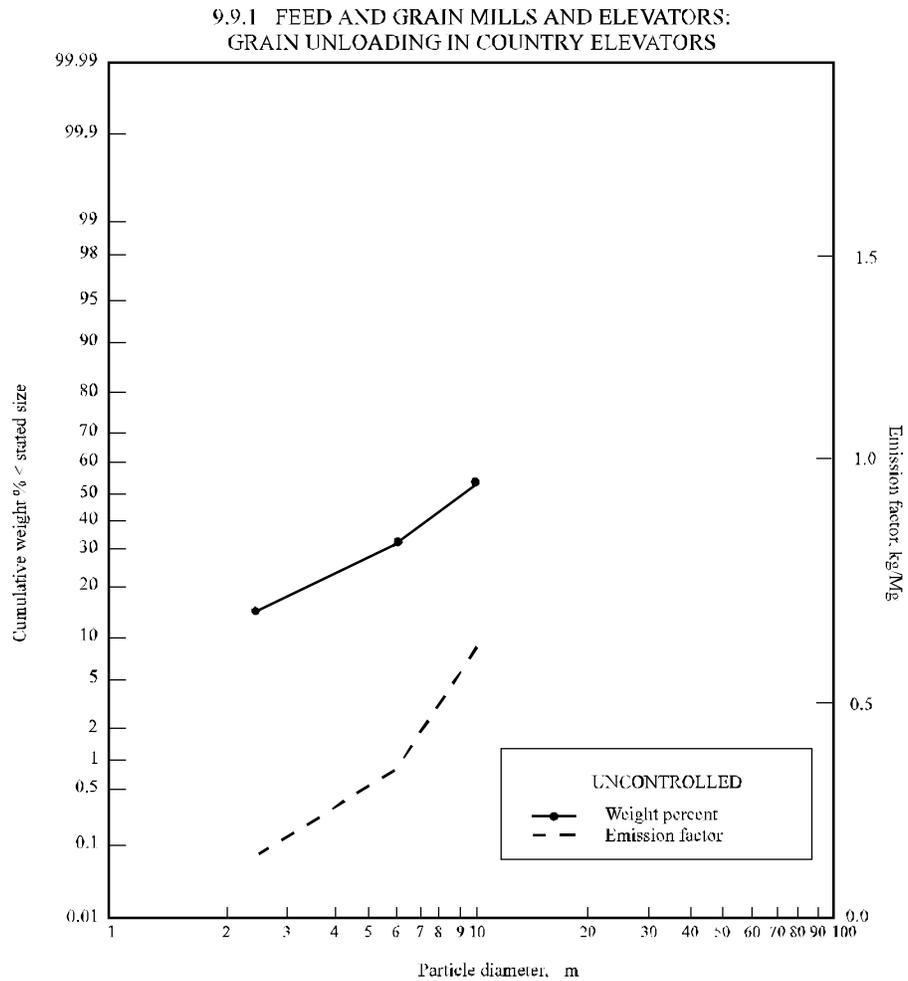
SAMPLING TECHNIQUE: Coulter counter

EMISSION FACTOR RATING: E

REFERENCE:

S. E. Hughs, *et al.*, "Collecting Particles From Gin Lint Cleaner Air Exhausts", presented at the 1981 Winter Meeting of the American Society Of Agricultural Engineers, Chicago, IL, December 1981.

## 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: GRAIN UNLOADING IN COUNTRY ELEVATORS



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Uncontrolled	Uncontrolled
2.5	13.8	0.13
6.0	30.5	0.33
10.0	49.0	0.56

9.9.1 FEED AND GRAIN MILLS AND ELEVATORS:  
GRAIN UNLOADING IN COUNTRY ELEVATORS

NUMBER OF TESTS: 2, conducted before control

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	13.8	30.5	49.0
Standard deviation (Cum. %):	3.3	2.5	—
Min (Cum. %):	10.5	28.0	49.0
Max (Cum. %):	17.0	33.0	49.0

TOTAL PARTICULATE EMISSION FACTOR: 0.3 kg particulate/Mg of grain unloaded, without control. Emission factor from AP-42, Section 9.9.1.

SOURCE OPERATION: During testing, the facility was continuously receiving wheat of low dockage. The elevator is equipped with a dust collection system that serves the dump pit boot and leg.

SAMPLING TECHNIQUE: Nelson Cascade Impactor

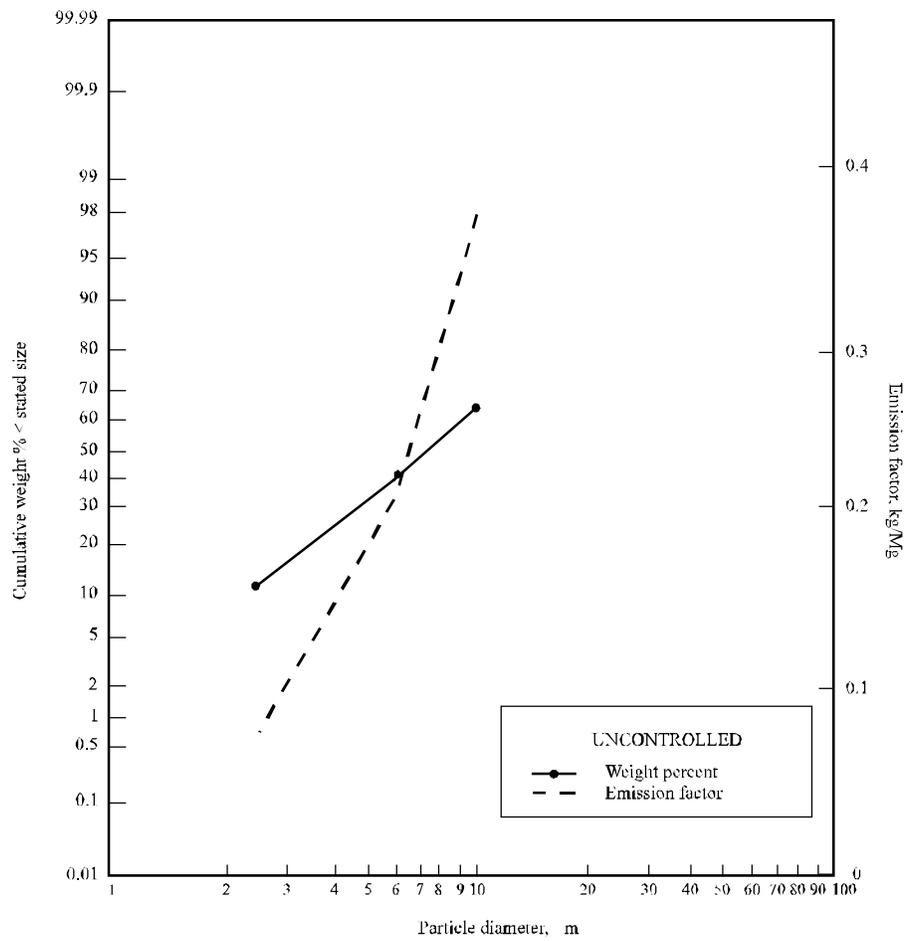
EMISSION FACTOR RATING: D

REFERENCES:

- a. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System (FPEIS), Series Report No. 154, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.
- b. *Emission Test Report, Uniontown Co-op, Elevator No. 2, Uniontown, WA*, Report No. 75-34, Washington State Department Of Ecology, Olympia, WA, October 1975.

## 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: CONVEYING

### 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: CONVEYING



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	16.8		0.08	
6.0	41.3		0.21	
10.0	69.4		0.35	

9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: CONVEYING

NUMBER OF TESTS: 2, conducted before control

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	16.8	41.3	69.4
Standard deviation (Cum. %):	6.9	16.3	27.3
Min (Cum. %):	9.9	25.0	42.1
Max (Cum. %):	23.7	57.7	96.6

TOTAL PARTICULATE EMISSION FACTOR: 0.5 kg particulate/Mg of grain processed, without control. Emission factor from AP-42, Section 9.9.1.

SOURCE OPERATION: Grain is unloaded from barges by "marine leg" buckets lifting the grain from the barges and discharging it onto an enclosed belt conveyer, which transfers the grain to the elevator. These tests measured the combined emissions from the "marine leg" bucket unloader and the conveyer transfer points. Emission rates averaged 1956 lb particulate/hour (0.67 kg/Mg grain unloaded). Grains are corn and soy beans.

SAMPLING TECHNIQUE: Brink Model B Cascade Impactor

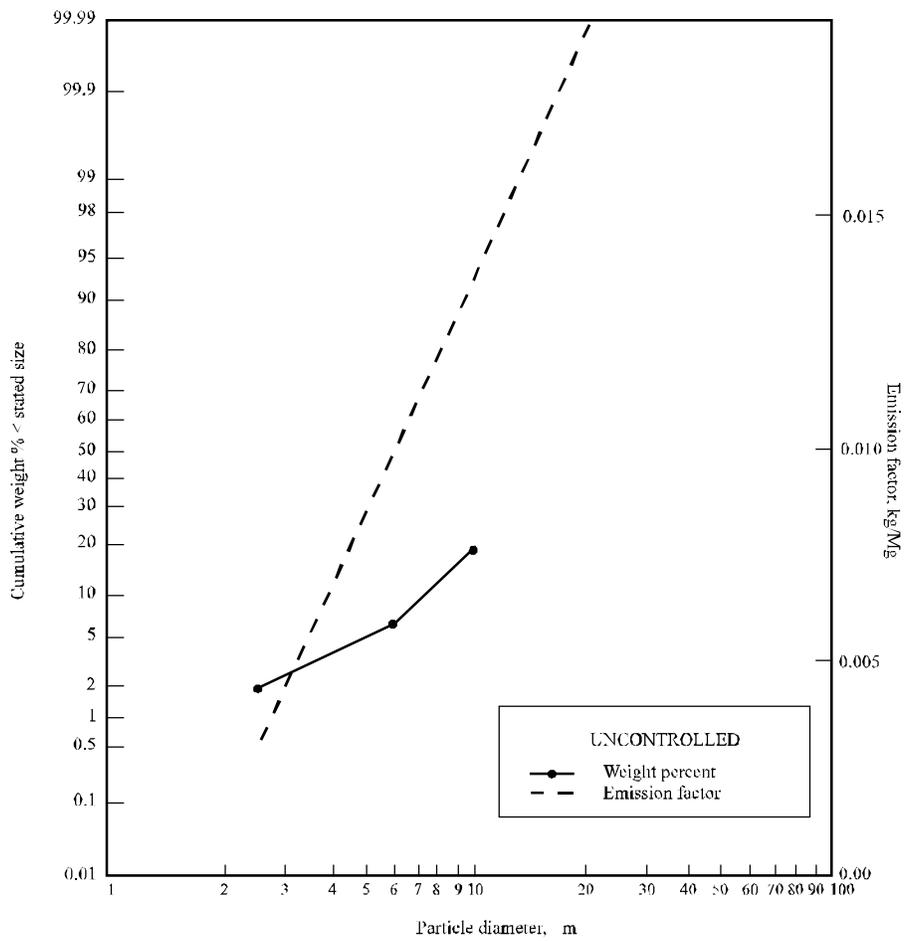
EMISSION FACTOR RATING: D

REFERENCE:

*Air Pollution Emission Test, Bunge Corporation, Destrehan, LA, EMB-74-GRN-7, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1974.*

## 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: RICE DRYER

### 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: RICE DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	2.0		0.003	
6.0	8.0		0.01	
10.0	19.5		0.029	

### 9.9.1 FEED AND GRAIN MILLS AND ELEVATORS: RICE DRYER

NUMBER OF TESTS: 2, conducted on uncontrolled source.

STATISTICS: Aerodynamic Particle Diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	2.0	8.0	19.5
Standard Deviation (Cum. %):	—	3.3	9.4
Min (Cum. %):	2.0	3.1	10.1
Max (Cum. %):	2.0	9.7	28.9

TOTAL PARTICULATE EMISSION FACTOR: 0.15 kg particulate/Mg of rice dried. Factor from AP-42, Section 9.9.1. Table 9.9.1-1, footnote b for column dryer.

SOURCE OPERATION: Source operated at 100% of rated capacity, drying 90.8 Mg rice/hr. The dryer is heated by 4 9.5-kw/hr burners.

SAMPLING TECHNIQUE: SASS train with cyclones

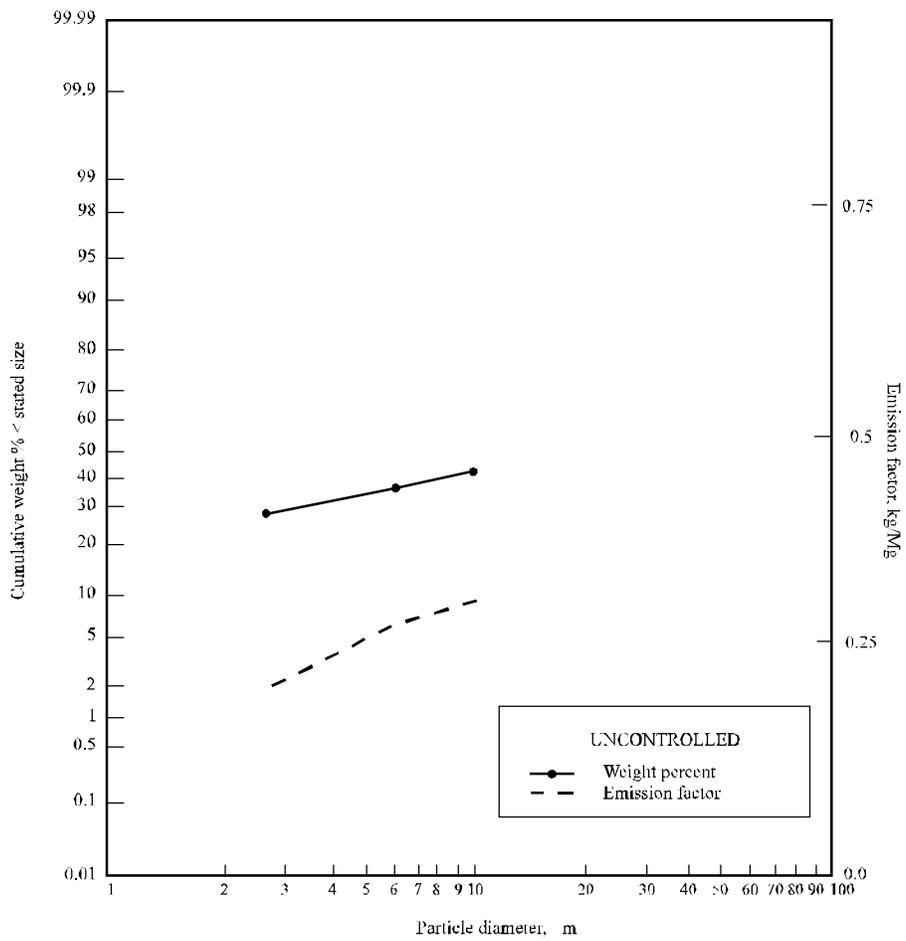
EMISSION FACTOR RATING: D

#### REFERENCES:

- a. H. J. Taback, *Fine Particle Emissions From Stationary And Miscellaneous Sources In The South Coast Air Basin*, PB 293 923/AS, National Technical Information Service, Springfield, VA, February 1979.
- b. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 228, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

## 9.9.2 FEED AND GRAIN MILLS AND ELEVATORS: CEREAL DRYER

9.9.2 FEED AND GRAIN MILLS AND ELEVATORS: CEREAL DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	
	Uncontrolled	
2.5	27	0.20
6.0	37	0.28
10.0	44	0.33

### 9.9.2 FEED AND GRAIN MILLS AND ELEVATORS: CEREAL DRYER

NUMBER OF TESTS: 6, conducted before controls

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	27	37	44
Standard deviation (Cum. %):	17	18	20
Min (Cum. %):	13	20	22
Max (Cum. %):	47	56	58

TOTAL PARTICULATE EMISSION FACTOR: 0.75 kg particulate/Mg cereal dried. Factor taken from AP-42, Section 9.9.2.

SOURCE OPERATION: Confidential

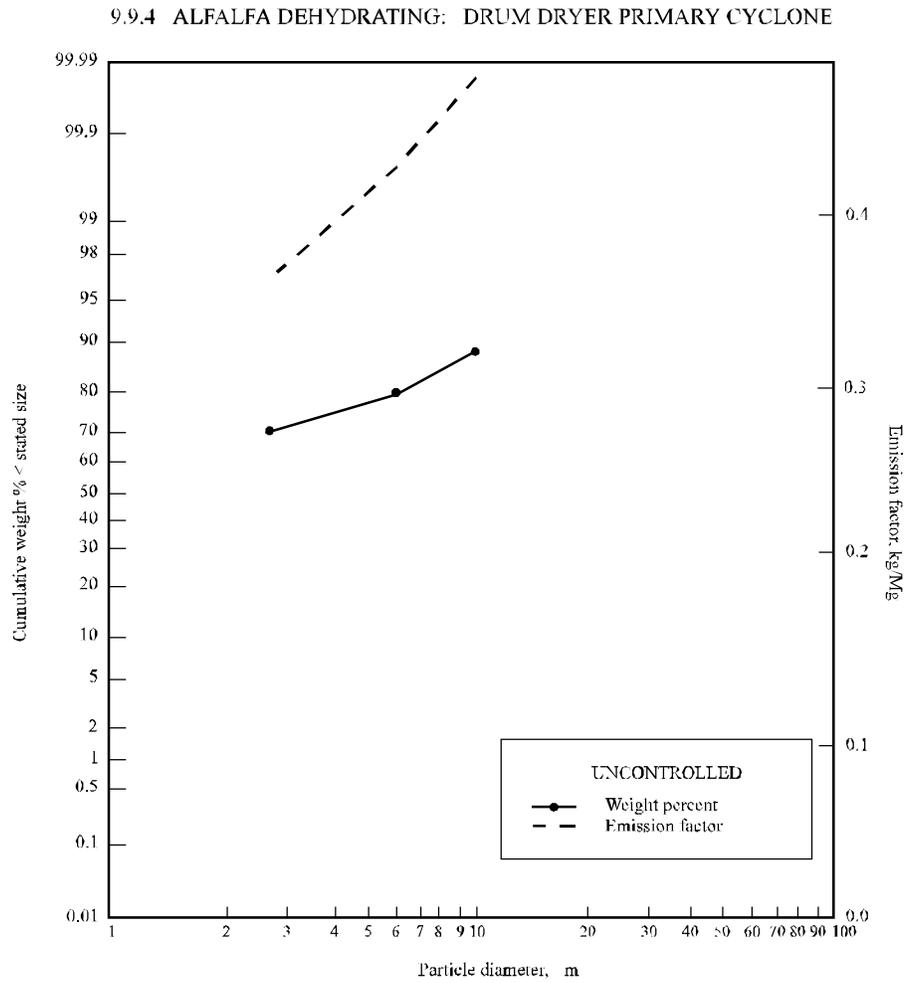
SAMPLING TECHNIQUE: Andersen Mark III Impactor

EMISSION FACTOR RATING: C

REFERENCE:

Confidential test data from a major grain processor, PEI Associates, Inc., Golden, CO, January 1985.

9.9.4 ALFALFA DEHYDRATING: DRUM DRYER PRIMARY CYCLONE

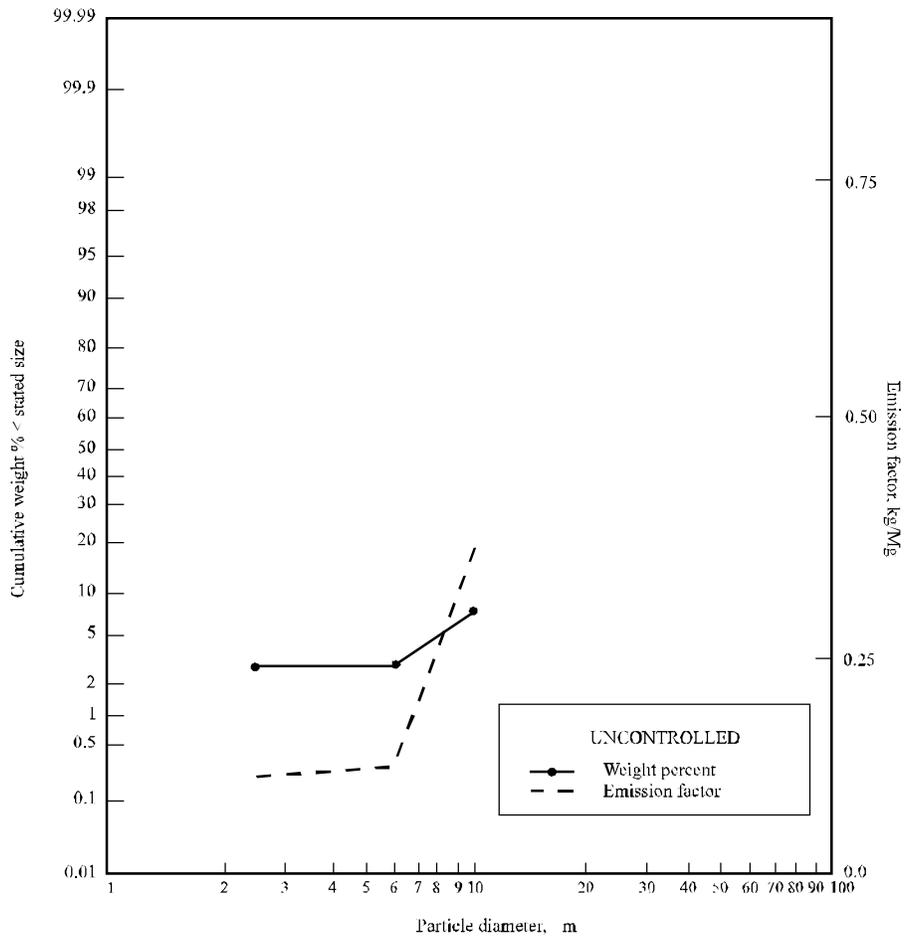


Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Uncontrolled	Uncontrolled
2.5	70.6	3.5
6.0	82.7	4.1
10.0	90.0	4.5



9.9.xx FEED AND GRAIN MILLS AND ELEVATORS: CAROB KIBBLE ROASTER

9.9.xx FEED AND GRAIN MILLS AND ELEVATORS: CAROB KIBBLE ROASTER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	3.0		0.11	
6.0	3.2		0.12	
10.0	9.6		0.36	

9.9.xx FEED AND GRAIN MILLS AND ELEVATORS: CAROB KIBBLE ROASTER

NUMBER OF TESTS: 1, conducted before controls

STATISTICS: Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
Mean (Cum. %):	3.0	3.2	9.6
Standard deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 3.8 kg/Mg carob kibble roasted. Factor from Reference a, p. 4-175.

SOURCE OPERATION: Source roasts 300 kg carob pods per hour, 100% of the design rate. Roaster heat input is 795 kJ/hr of natural gas.

SAMPLING TECHNIQUE: Joy train with 3 cyclones

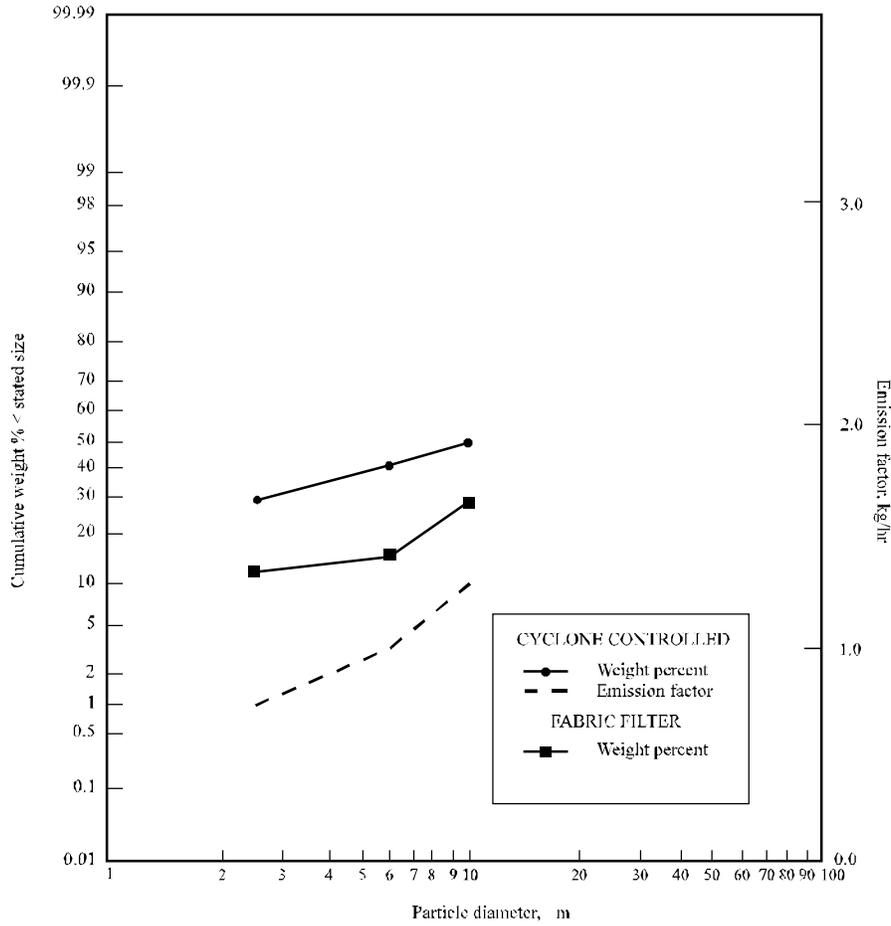
EMISSION FACTOR RATING: E

REFERENCES:

- a. H. J. Taback, *Fine Particle Emissions From Stationary And Miscellaneous Sources In The South Coast Air Basin*, PB 293 923/AS, National Technical Information Service, Springfield, VA, February 1979.
- b. Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System Series, Report No. 229, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

## 10.5 WOODWORKING WASTE COLLECTION OPERATIONS: BELT SANDER HOOD EXHAUST CYCLONE

10.5 WOODWORKING WASTE COLLECTION OPERATIONS:  
BELT SANDER HOOD EXHAUST CYCLONE



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/hr of cyclone operation
	Cyclone	After cyclone and fabric filter	After cyclone collector
2.5	29.5	14.3	0.68
6.0	42.7	17.3	0.98
10.0	52.9	32.1	1.22

10.5 WOODWORKING WASTE COLLECTION OPERATIONS:  
BELT SANDER HOOD EXHAUST CYCLONE

NUMBER OF TESTS: (a) 1, conducted after cyclone control  
(b) 1, after cyclone and fabric filter control

STATISTICS: (a)	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	29.5	42.7	52.9
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			
(b)	Aerodynamic particle diameter ( $\mu\text{m}$ ):	2.5	6.0	10.0
	Mean (Cum. %):	14.3	17.3	32.1
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 2.3 kg particulate/hr of cyclone operation. For cyclone-controlled source, this emission factor applies to typical large diameter cyclones into which wood waste is fed directly, not to cyclones that handle waste previously collected in cyclones. If baghouses are used for waste collection, particulate emissions will be negligible. Accordingly, no emission factor is provided for the fabric filter-controlled source. Factors from AP-42.

SOURCE OPERATION: Source was sanding 2-ply panels of mahogany veneer, at 100% of design process rate of 1110 m<sup>2</sup>/hr.

SAMPLING TECHNIQUE: (a) Joy train with 3 cyclones  
(b) SASS train with cyclones

EMISSION FACTOR RATING: E

REFERENCE:

Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 238, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.