

**APPENDIX K**  
**Area Sources**

## **Introduction**

The estimation of inhalable particulate matter (PM<sub>10</sub>) emissions from area sources involves many varied procedures. Generally, an activity factor associated with a type of equipment or activity, such as farm tractors or trash burning is used in conjunction with an appropriate emission factor for estimating emissions from area sources. Examples of activity factors are: population, number of households, and aircraft landings and takeoffs (LTOs).

The procedures and methodologies for estimating PM<sub>10</sub> emissions from area sources in El Paso County are discussed by source category. In addition to addressing non-highway mobile source and stationary area source emissions methodology, a separate discussion is provided for methodologies used for estimating emissions for the colonias areas in El Paso County. A discussion of each source category, including references, activity factors, calculations, and other data is presented.

## **COUNTYWIDE INDUSTRIAL, CONSTRUCTION, AND AGRICULTURAL EQUIPMENT**

### **Industrial Equipment**

Countywide emissions from industrial equipment were calculated for each equipment category by applying the appropriate emission factors to the county employment in specific fields. County

business patterns were used to obtain the number of employees in specific industrial fields. Annual work output estimates by engine type were derived from Environmental Protection Agency's (EPA's) Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources. The Compilation of Air Pollution Emissions Factors (AP-42) emission factor applied was 0.00066 tons/county employee for PM<sub>10</sub>. Tables 3-6, 3-7, in paragraph 3.3 from the EPA document Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources were used to calculate emissions from industrial equipment. Additionally, tables II-7-1 and 7-2 of AP-42 were referenced to obtain emission factors for each category of equipment. The factor unit selected was grams per horse power hour (grams/hp-hour). The document Texas County Business Patterns was used to obtain the number of employees in the following Standard Industrial Classification (SIC) Divisions:

- Division B: Mining,
- Division D: Manufacturing, and
- Division F: Wholesale Trade.

El Paso County's population for the above SIC divisions is 43,293. In order to estimate PM<sub>10</sub> emissions from these divisions, county data was ratioed to national data. The national data used in this ratio is shown below.

- o National Employment . . . . . 25,713,763 persons
- o National Heavy-Duty Diesel . . . . . 417,000 engines
- o National Gasoline . . . . . 3,095,400 engines
- o National Diesel Engine
  - Work Output . . . . . 22,500 hp-hr/yr
- o National Gas Engine
  - Work Output . . . . . 7,360 hp-hr/yr

Therefore, to estimate PM<sub>10</sub> emissions from both diesel and gasoline equipment from Industrial Equipment, the Texas Air Control Board (TACB) used the following procedure:

A constant is derived for both gasoline and diesel combustion.

Then:

**Diesel Combustion**

$$\begin{aligned}
 C_{\text{diesel}} &= \frac{43,293 \text{ pop.} \times 417,000 \text{ eng.} \times 22,500 \text{ hp-hr} \times \text{lb.} \times T \times 0.902 \text{ gms.}}{25,713,763 \text{ pop.} \times 453.6 \text{ gms.} \times 2,000 \text{ lbs.} \times \text{hp-hr}} \\
 &= 43,293 \times 0.000363 \\
 &= 15.7 \text{ T/Yr}
 \end{aligned}$$

**Gasoline Combustion**

$$\begin{aligned}
 C_{\text{gas}} &= \frac{43,293 \text{ pop.} \times 3,095,400 \text{ eng.} \times 7,360 \text{ hp-hr} \times \text{lb.} \times T \times 0.303 \text{ gms.}}{25,713,763 \text{ pop.} \times 453.6 \text{ gms.} \times 2,000 \text{ lbs.} \times \text{hp-hr}} \\
 C_{\text{gas}} &= 43,293 \times 0.000296 \\
 &= 12.8 \text{ T/Yr}
 \end{aligned}$$

Total gasoline and diesel:

$$\begin{aligned}
 \text{PM}_{10} &= 15.7 + 12.8 \text{ T/Yr} \\
 &= 28.5 \text{ T/Yr}
 \end{aligned}$$

## Construction Equipment

Emissions were calculated for each category type by using a primary factor relating to the annual hours of use of the equipment. The hours of use statistic provided a basis for deriving the activity factor, which, once determined, was applied to an emission factor to yield emissions. County business patterns were used to obtain the number of employees in specific construction fields. Hours of use were derived from EPA's Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources. The AP-42 emission factor applied was 0.0011 tons/capita (T/capita) for PM<sub>10</sub>.

Tables 3-3, 3-4, and 3-5 in paragraph 3.2 of the EPA document, Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources were used to calculate emissions from each type of equipment. Also, tables II-7-1 and 7-2 of AP-42 were used to calculate emissions for each category of equipment. The factor unit selected was gms/hp-hr. The document Texas County Business Patterns was used to obtain employees in SIC Group 16 (Construction other than building construction—general contractors) as shown below:

o National Employment . . . . .	693,078
o Texas . . . . .	106,634
o 1988 Texas population . . . . .	16,895,781

Using the method described in paragraph 3.2, Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources, a constant was determined for the SIC 16 ratio and population ratio.

El Paso County's 1990 population was 591,610. Therefore, to estimate PM<sub>10</sub> emissions from both diesel and gasoline equipment from Construction Equipment, the TACB used the following procedure:

$$\begin{aligned}\text{Constant} &= \frac{106,634 \times 591,610 \text{ pop.} \times \text{lb.} \times \text{T}}{693,078 \times 16,895,781 \times 453.6 \text{ gms.} \times 2,000 \text{ lbs.}} \\ \text{Constant} &= 591,610 \text{ pop.} \times 1.0037 \times 10^{-12}\end{aligned}$$

The emissions were calculated for all the equipment in Tables 3-3, 3-4, and 3-5.

$$\begin{aligned}\text{PM}_{10} &= \text{Constant} \times \text{Emission Factors} \\ &= 0.0011 \times 591,610 \text{ pop.} \\ &= 644 \text{ T/Yr}\end{aligned}$$

#### **Agricultural Equipment (Farm Equipment)**

The Texas State Department of Agriculture equipment reference Census of Agriculture was used to obtain the total number of different types of equipment, both gasoline and diesel fueled, for each county. The reference does not indicate the number of gasoline or diesel fueled equipment separately. However, Table II-6.2 AP-42 shows an average of 50 percent of farm equipment is diesel while the remaining is gasoline fueled. The reference indicates approximately 30 percent of tractors are diesel fueled; however,

the TACB estimates the number of diesel fueled tractors to be closer to 50 percent. The emission factors were derived from Table 3-2 of EPA's Procedures for Emissions Inventory Preparation - Volume IV: Mobile Sources. Emissions were determined by calculating annual fuel use for different types of equipment and applying Table II-6.2 of EPA's AP-42 emission factors based on the fuel usage. Table II-6.2 in AP-42 provides the following factors for two categories of farm equipment, tractors and nontractors using gasoline or diesel fuel. The factors are given in lbs/1,000 gal. fuel:

- o Gasoline tractors, 8.0 lbs. for  $PM_{10}$ /1,000 gal.;
- o Gasoline nontractors, 6.86 lbs. for  $PM_{10}$ /1,000 gal.;
- o Diesel tractors, 45.7 lbs. for  $PM_{10}$ /1,000 gal.; and
- o Diesel nontractors, 51.3 lbs. for  $PM_{10}$ /1,000 gal.

Table K-1 lists the number and type of all farm equipment currently in use in El Paso County and the amount of fuel consumed by each type.

TABLE K-1

Agricultural Farm Equipment  
El Paso County, 1990

Equipment (Unit)	Total No. in County	Fuel Used per Unit (Gals.)	Total Gasoline (Gals.)	Total Diesel (Gals.)
Combines				
Gasoline	15	166	2,490	
Diesel	15	107		1,605
Balers				
Gasoline	50	56	2,800	
Diesel	50	36		1,800
Harvesters				
Gasoline	69	281	19,389	
Diesel	69	180		2,420
General Purpose				
Gasoline	39	176	6,864	
Diesel	39	97		3,783
Tractors				
Gasoline	365	663	241,995	
Diesel	365	1,460		532,900
TOTALS			273,538	542,508

Therefore, to estimate PM<sub>10</sub> emissions from farm equipment for both gasoline and diesel, the following calculations were performed using the above emission factors.

**Gasoline**

$$\begin{aligned}
 \text{PM}_{10} &= \frac{[(8.0 \times 241,995) + (6.86 \times 31,543)] \times \text{lb.} \times \text{T}}{1,000 \text{ gal.} \times 2,000 \text{ lb.}} \\
 &= \frac{[1,935,960 + 216,385]}{1,000 \text{ gal.} \times 2,000 \text{ lb.}} \\
 &= 1.1 \text{ T/Yr}
 \end{aligned}$$

**Diesel**

$$\begin{aligned}
 \text{PM}_{10} &= \frac{[(45.7 \times 552,508) + (51.3 \times 19,608)] \times \text{lb} \times \text{T}}{1,000 \text{ gal.} \times 2,000 \text{ lb}} \\
 &= 13.1 \text{ T/Yr}
 \end{aligned}$$

$$\text{Total PM}_{10} = 1.1 + 13.1 = 14.2 \text{ T/Yr}$$

## Agricultural Tilling

The following equation was referenced from AP-42, Paragraph 11.2.2, and Texas County Statistics provided a number of acres being tilled.

$$E = K(4.8) S^{0.6} \text{ (lb./acre)}$$

$$\text{where: } K = 0.21 \text{ for } PM_{10},$$

$$S = 18 \text{ percent}$$

$$\begin{aligned} PM_{10} &= \frac{.21 \times 4.8 \times 18^{0.6} \times 359,000}{2,000 \text{ lb.}} \\ &= 126 \text{ T/Yr} \end{aligned}$$

## Natural Gas Combustion - Residential/Commercial

The Texas Railroad Commission - Annual Report, page 17, reports that in Texas for 1988 the average annual consumption of natural gas was 67 million cubic feet (MCF) per capita and there were 3,006,185 residential natural gas customers.

### Residential

$$\begin{aligned} \text{MCF/capita} &= \frac{3,006,185 \times 67 \text{ MCF}}{16,895,781} \\ &= 11.921 \end{aligned}$$

The emission factor from AP-42, Table 1.4.1 is:

$$PM_{10} = \frac{3 \text{ lb.}}{10^6 \text{ ft.}^3}$$

$$\begin{aligned} PM_{10} \text{ T/capita} &= \frac{11.921 \text{ MCF} \times T \times 3 \text{ lb.}}{32,000 \text{ lb.} \times 10^6 \text{ ft.}^3} \\ &= 0.000018 \end{aligned}$$

Then for El Paso,

$$\begin{aligned} PM_{10} &= 591,610 \times 0.000018 \\ &= 11 \text{ T/Yr} \end{aligned}$$

### **Commercial**

The Texas Railroad Commission - Annual Report, page 105, shows that in Texas for 1988 the small commercial and industrial total gas usage was 151,937,324 MCF.

$$\begin{aligned} \text{MCF/capita} &= \frac{151,937,324}{16,895,781} \\ &= 8.993 \end{aligned}$$

$$\begin{aligned} PM_{10} \text{ Tons/capita} &= \frac{8.993 \text{ MCF} \times T \times 3 \text{ lb.}}{2,000 \text{ lb.} \times 10^6 \text{ ft.}^3} \\ &= 0.000013 \end{aligned}$$

Then for El Paso,

$$\begin{aligned} PM_{10} &= 591,610 \times 0.000013 \\ &= 7 \text{ T/Yr} \end{aligned}$$

## Railroads

PM<sub>10</sub> emissions from railroads are produced by the combustion of diesel fuel. Emission factors for railroads in AP-42 are based on pounds PM<sub>10</sub>/10<sup>3</sup> gals. of fuel combusted. To determine the quantity of fuel consumed in El Paso County, the Texas Railroad Commission document Texas Railroad Facts was used. This document does not, however, provide fuel consumed by railroads by county, only for the entire state. Information from the Texas Property Tax Board shows there are 339.98 miles of track in El Paso County. Therefore, the TACB ratioed total fuel consumed in the state to total miles of track in the state to miles of track in El Paso County in order to derive total fuel consumed in the county. Once the quantity of fuel used by railroads in the county was determined, Table II-2.1 in AP-42 was used. This table shows an emission factor of 25 lbs. PM<sub>10</sub> per 1,000 gals. of fuel used.

This was used to derive tons/track mile factor of 0.185 tons PM<sub>10</sub> per track mile which was applied to the total railroad mileage for the county.

Then for El Paso:

$$\begin{aligned} \text{PM}_{10} &= 0.185 \text{ T/mile track/Yr.} \times 339.98 \text{ miles track} \\ &= 63 \text{ T/Yr.} \end{aligned}$$

## Aviation

Aircraft emissions were calculated by applying emission factors for each category (general, commercial, and military) to the number of aircraft LTOs for airports.

The following factors from EPA's Procedures for Emission Inventory Preparation - Volume IV: Mobile Sources were used:

- Commercial aircraft, 1.18 lbs. PM<sub>10</sub>/LTO;
- Military aircraft, 15.23 lbs. PM<sub>10</sub>/LTO; and
- General aircraft, 0.02 lbs. PM<sub>10</sub>/LTO.

LTOs for commercial aircraft came from the Airport Activity Statistics - Certified Route Carriers. The Federal Aviation Administration provided LTOs for general and military aircraft.

### General Aircraft

$$\begin{aligned} \text{PM}_{10} &= 93,246 \times \frac{0.02}{2,000} \\ &= 0.9 \text{ T/Yr} \end{aligned}$$

### Commercial Aircraft

$$\begin{aligned} \text{PM}_{10} &= 24,520 \times \frac{1.18}{2,000} \\ &= 14.5 \text{ T/Yr} \end{aligned}$$

### **Military Aircraft**

$$\begin{aligned} \text{PM}_{10} &= 4,505 \times \frac{15.23}{2,000} \\ &= 34.4 \text{ T/Yr} \end{aligned}$$

### **Total Aircraft**

$$\begin{aligned} \text{PM}_{10} &= 0.9 + 14.5 + 34.4 \\ &= 49.7 \text{ T/Yr} \end{aligned}$$

### **Residential Fireplaces (City of El Paso)**

Based on conversations with the El Paso Metropolitan Planning Office, the TACB estimated  $\text{PM}_{10}$  emissions from fireplaces (for this discussion fireplaces will include fireplaces, wood burning stoves, and other heating devices that combust wood) in the City of El Paso using the following estimates:

- o 10 percent of the households in El Paso have fireplaces;
- o 10 percent of the people with fireplaces use them for heating; and
- o 90 percent of the people with fireplaces use them only one day per week during the winter season.

The following from the 1990 U.S. Census Data was used:

- o El Paso County population . . . . . 591,610
- o Total number of households . . . . . 187,473

There are an estimated:

- o Total number of colonia households . . . . . 11,383
- o Number of households less colonias . . . . . 176,090

Paragraph 4.5-4 of Procedures for the Preparation of Emissions Inventories for Precursors of Ozone: Volume 1 -- September, 1988 gives an equation for determining the amount of wood burned in a fireplace in T/Yr.

$$\text{Wood Consumption} = 0.0017 \times H_w \times \text{HDG} \times [(\text{ARPH})/5]$$

- Where:  $H_w$  = Number houses heating with wood  
HDG = Heating Degree Days  
ARPH = Average Rooms Per House

For El Paso the average house has five rooms and the number of heating degree days is typically 2,469 per year. For houses that use the fireplace only one day per week, the typical winter heating degree day value is 353.

Households using fireplace for heat:

$$\begin{aligned}\text{Wood Consumption} &= 0.0017 \times (0.01 \times 176,000) \times 2,469 \times (5/5) \\ &= 7,387 \text{ T/Yr}\end{aligned}$$

From Table 1.9-1 AP-42 the emission factor is 28 lbs./T of wood burned so,

$$\begin{aligned}\text{PM}_{10} &= \frac{7,387 \text{ T} \times 28 \text{ lbs./T}}{2,000 \text{ lbs./T}} \\ &= 103 \text{ T/Yr}\end{aligned}$$

Households using fireplace one day per week:

$$\begin{aligned}\text{Wood Consumption} &= 0.0017 \times (0.09 \times 176,000) \times 353 \times (5/5) \\ &= 9,498 \text{ T/Yr}\end{aligned}$$

Using the emission fractor from Table 1.9-1 AP-42,

$$\begin{aligned}\text{PM}_{10} &= \frac{9,498 \text{ T} \times 28 \text{ lbs./T}}{2,000 \text{ lbs./T}} \\ &= 133 \text{ T/Yr}\end{aligned}$$

Total  $\text{PM}_{10}$  emissions from fireplaces in El Paso:

$$\begin{aligned}\text{PM}_{10} &= 103 + 133 \\ &= 236 \text{ T/Yr}\end{aligned}$$

## Colonias

There are an estimated 11,383 colonia households. Based on visual observation of the colonia areas in El Paso County, the

TACB estimated 20 percent of the households have a fireplace or other wood burning device. Also, based on the same observation, it was estimated 80 percent of the households heat with liquid petroleum gas (LPG). No heating of households is done by electricity or natural gas.

PM<sub>10</sub> emissions from home heating in the colonias was estimated by the TACB for wood combustion and LPG.

### Heating

#### Fireplaces or Other Combustion Devices

Paragraph 4.5.4, Procedures for the Preparation of Emissions Inventories for Precursors of Ozone: Volume 1 -- September, 1988 gives an equation for determining the amount of wood burned in a fireplace in T/Yr. The number of households with fireplaces is 2,277 and the number of Heating Degree Days (HDG) is 2,469.

$$\begin{aligned}\text{Wood Consumption (T/Yr)} &= (0.0017) \times (\text{no. of houses}) \times (\text{HDG}) \\ &= (0.0017) \times (2,277) \times (2,469) \\ &= 9,557 \text{ T/Yr}\end{aligned}$$

Table 1.9-1, AP-42 emission factor - residential fireplaces:

$$\begin{aligned} \text{PM}_{10} &= 28 \text{ lbs/T wood burned} \\ \text{PM}_{10} &= \frac{28 \text{ lbs. wood} \times 9,557 \text{ T}}{\text{Yr} \times 2,000 \text{ lbs.}} \\ &= 134 \text{ T/Yr} \end{aligned}$$

**LPG Combustion**

Table 4.5.3: Procedures for the Preparation of Emissions Inventories for Precursors of Ozone: Volume 1 - September, 1988:

Households heating with LPG: . . . . . 9,106

Number of therms: (376 + 0.209 B)(H)

(one therm = 100,000 british thermal units (BTUs))

Where: B = Annual heating degree days  
H = Number of homes using LPG

$$\begin{aligned} \text{Number of therms} &= (376 + 0.209 \times 2,469) \times (9,106) \\ &= 8.113 \times 10^8 \text{ BTUs} \end{aligned}$$

$$\begin{aligned} \text{Amount of LPG} &= \frac{8.113 \times 1,000 \text{ BTUs}}{974,000 \text{ BTUs}} \\ &= 8,330 \text{ gals} \end{aligned}$$

From Table 1.5-1 AP-42, emission factor (lbs/1,000 gals.)

$$\begin{aligned} \text{PM}_{10} &= \frac{0.27 \text{ lbs.} \times 8,330 \text{ gals.}}{2,000 \text{ lbs.}} \\ &= 1 \text{ T/Yr} \end{aligned}$$

## Trashburning

The population of the colonias is 68,300 and 70 percent of homes burn trash.

From Table 4.4-2, Procedures for the Preparation of Emissions Inventories for Precursors of Ozone: Volume 1 -- September, 1988:

$$\begin{aligned}\text{Amount of Trash} &= 450 \text{ T/Yr}/1,000 \text{ pop.} \\ &= \frac{450 \text{ tons} \times 0.7 \times 68,300 \text{ pop.}}{1,000 \text{ pop.}} \\ &= 21,515 \text{ T/Yr}\end{aligned}$$

From Table 2.4-1, AP-42 emission factors

$$\begin{aligned}\text{PM}_{10} &= \frac{16 \text{ lbs} \times 21,515 \text{ tons}}{2,000 \text{ lbs} \times \text{yr}} \\ &= 172 \text{ T/Yr}\end{aligned}$$