February 2004

Emission Factor Documentation for AP-42 Section 11.1

Hot Mix Asphalt Plants

Final Report

Prepared for

U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Measurement Center
Research Triangle Park, NC 27711

RTI Contract No. AGMT DTD 10/31/02
RTI Project No. 08682

Prepared by

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NOTICE

The information in this document has been funded in part by the National Asphalt Pavement Association for the U.S. Environmental Protection Agency (EPA) under Contract No. AGMT DTD 10/31/02 to RTI International. It has been reviewed by the EPA Office of Air Quality Planning and Standards and has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EMISSION FACTOR DOCUMENTATION FOR AP-42 SECTION 11.1
HOT MIX ASPHALT PLANTS

1. INTRODUCTION

The document Compilation of Air Pollutant Emissions Factors (AP-42) has been published by the U. S. Environmental Protection Agency (EPA) since 1972. Supplements to AP-42 have been routinely published to add new emission source categories and to update existing emission factors. AP-42 is routinely updated by EPA to respond to new emission factor needs of EPA, State, and local air pollution control programs, and industry.

An emission factor relates the quantity (weight) of pollutants emitted to a unit of activity of the source. The uses for the emission factors reported in AP-42 include:

1. Estimates of areawide emissions;
2. Estimates of emissions for a specific facility; and
3. Evaluation of emissions relative to ambient air quality.

The purpose of this report is to provide background information from test reports and other information to support revisions to AP-42 Section 11.1, Hot Mix Asphalt Plants.

This background report consists of five sections. Section 1 includes the introduction to the report. Section 2 gives a description of the hot mix asphalt (HMA) industry. It includes a characterization of the industry, an overview of the different process types, a description of emissions, and a description of the technology used to control emissions resulting from HMA production. Section 3 is a review of emission data collection and analysis procedures. It describes the literature search, the screening of emission data reports, and the quality rating system for both emission data and emission factors. Section 4 details revisions to the existing AP-42 section narrative and pollutant emission factor development. It includes the review of specific data sets and the results of data analysis. The final AP-42 Section 11.1, Hot Mix Asphalt Plants, is presented separately.

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2. INDUSTRY DESCRIPTION[1,3-6]

Hot mix asphalt (HMA) paving materials are a mixture of size-graded, high quality aggregate (which can include reclaimed asphalt pavement [RAP]), and liquid asphalt cement, which is heated and mixed in measured quantities to produce HMA. Aggregate and RAP (if used) constitute over 92 percent by weight of the total mixture. Aside from the amount and grade of asphalt cement used, mix characteristics are determined by the relative amounts and types of aggregate and RAP used. A certain percentage of fine aggregate (less than 74 micrometers [µm] in physical diameter) is required for the production of good quality HMA.

Hot mix asphalt paving materials can be manufactured by: (1) batch mix plants, (2) continuous mix (mix outside dryer drum) plants, (3) parallel flow drum-mix plants, and (4) counterflow drum-mix plants. This order of listing generally reflects the chronological order of development and use within the HMA Industry.

There are approximately 3,600 active asphalt plants in the United States. Of these, approximately 2,300 are batch plants, 1,000 are parallel flow drum-mix plants, and 300 are counterflow drum-mix plants. About 85 percent of plants being manufactured today are of the counterflow drum-mix design, while batch plants and parallel flow drum-mix plants account for 10 percent and 5 percent respectively.

Continuous mix plants (type 2 above) represent a very small fraction of the plants in use (½ percent or less) and, therefore, are not discussed further nor are any data presented for this type of plant.

An HMA plant can be constructed as a permanent plant, a skid mounted (easily relocated) plant, or as a portable plant. All plants can have RAP processing capabilities. Virtually all of the plants manufactured today have RAP processing capability.

2.1 CHARACTERIZATION OF THE INDUSTRY

The 1996 U. S. Geological Survey (USGS) Minerals Yearbook was consulted to develop an estimate of the annual production of HMA (1996 had the greatest reported use of bituminous aggregate). Information useful for estimating HMA production is divided between reports on Crushed Stone and Construction Sand and Gravel within the yearbook. Within these two categories, the information is further divided.

The following information is presented in Table 13 in the Crushed Stone section of the 1996 USGS Minerals Yearbook (the unspecified category includes production reported without a breakdown by end use and estimates for nonrespondents):

Coarse aggregate, graded:	
Bituminous aggregate, coarse	88,900,000 metric tons (Mt) (also called Megagrams [Mg])
Bituminous surface-treatment aggregate	22,900,000 Mt
Fine aggregate (-3/8 inch):	
Stone sand, bituminous mix or seal	25,500,000 Mt
Special:	
Asphalt fillers or extenders	1,280,000 Mt

Unspecified:	
Actual	370,000,000 Mt
Estimated	182,000,000 Mt
Total	1,330,000,000 Mt

In addition, Table 20 in the Crushed Stone section of the 1996 USGS Minerals Yearbook presents a total of 1,350,000 Mt of recycled asphalt for 1996.

The following information is presented in Table 6 in the Construction Sand and Gravel section of the 1996 USGS Minerals Yearbook (the unspecified category includes production reported without a breakdown by end use and estimates for nonrespondents):

Asphaltic concrete aggregates and other bituminous mixtures	70,800,000 Mt
Unspecified:	
Actual	174,000,000 Mt
Estimated	203,000,000 Mt
Total	914,000,000 Mt

In addition, Table 14 in the Construction Sand and Gravel section of the 1996 USGS Minerals Yearbook presents a total of 3,740,000 Mt of recycled asphalt for 1996.

Both sections in the Minerals Yearbook recommend that the unspecified uses categories be distributed as the specified uses categories. Adjusting the total crushed stone production of 1,330,000,000 Mt to the ratio of reported total specified use totals for HMA usage verses the total specified uses of crushed stone yields 236,904,000 Mt (1,330,000,000 x (138,580,000 ÷ 778,000,000). Adjusting the total sand and gravel production of 914,000,000 Mt to the ratio of reported total specified HMA usage verses the total specified uses for sand and gravel yields 120,505,000 Mt (914,000,000 x (70,800,000 ÷ 537,000,000). Asphalt is added to this newly quarried aggregate total of 357,409,000 Mt to produce HMA that is 6 percent asphalt (or 94 percent aggregate) to yield 380,222,000 Mt of HMA. In addition to newly quarried aggregate, the USGS reported that a total of 5,090,000 Mt of recycled asphalt was used in HMA. Based on these reported values from USGS, the production of HMA for 1996 is estimated to be 385,312,000 Mt or 424,614,000 tons. However, given the emphasis on recycling in State paving contracts, a recycled asphalt to new HMA ratio of only 1.3 percent appears very low and is probably significantly under estimated.

In a 1993 joint Federal Highway Administration and EPA report (A Study of the Use of Recycled Paving Material - Report to Congress; FWHA-RD-93-147; EPA 600/R-93-095; June 1993), it was estimated that 73 million metric tons (80.4 million tons) of RAP were recycled annually. This report documents several methods of reprocessing RAP for reuse as pavement or other materials. However, the report does not provide estimates of reprocessing by each method. Based on this report, EPA concluded that the majority of RAP reprocessing is in HMA plants. Assuming all of the RAP is reprocessed in HMA plants, an early 1990's upper bound estimate of 16.1 percent recycled asphalt produced can be calculated. Recognizing that this estimate includes reprocessing not in HMA plants, EPA examined an alternative method of estimating national RAP usage in HMA plants.

At Plants C and D between 80 and 90 percent of the asphalt produced included RAP. When RAP was used, Plants C and D included 30 percent and 10 percnet RAP in their respective final asphalt mixes during EPA emission testing. Extrapolating this production information to an annual estimate, Plants C and D use between 8 and 27 percent RAP with a midpoint of 17.5 percent. While this number is larger than the FHA derived upper bound estimate of 16.1 percent, it may be more representative of RAP usage rates in the late 1990's. Using the midpoint (17.5 percent) of this range yields a revised RAP usage of

80,653,000 Mg (88,905,000 tons). Using the revised RAP usage yields a total estimated HMA production for 1996 of 469,102,000 Mg or 517,096,000 tons.

Information provided by the HMA industry indicates that HMA is produced by approximately 2,300 batch plants and 1,300 drum-mix plants. Using a national asphalt production estimate of 517 million tons of HMA, an estimate of the national annual production capacity at drum and batch mix plants was determined as follows:

Based on available production capacity data from emission compliance tests of 98 batch mix plants and 162 drum-mix plants, the average maximum production rates are:

Batch – 214 tons/hr
Drum – 272 tons/hr

Extrapolating these averages to the entire HMA industry yields an estimated, theoretical national production capacity of 7,409 million tons of HMA if all plants could operate 8760 hours in a year. The 2,300 batch mix plants would produce 4,311.7 million tons and the 1,300 drum mix plants would produce 3,097.5 million tons.

Based upon the above estimates of HMA production and available plant capacity, the estimated utilization rate of the industry is only about 7 percent (517 million ÷ 7,409 million). This significant under utilization is caused by limitations on when pavements can be laid, including limitations created by weather conditions, contract specifications on times of the day when pavement construction can be performed, the local demands for paving construction and repair, the distance that HMA can be trucked to a paving site, the desire to be able to meet short term peak production demands, and a variety of other factors. A number of differences between drum and batch mix asphalt plants suggest the estimated 7 percent utilization ratio is not likely to be equal distributed among batch mix and drum mix plants. These differences include:

1. production methods,
2. capability to make and store product ahead of the time,
3. ability for loading to occur significantly quicker at facilities with storage silos,
4. the general lack of storage capability at batch mix plants, and
5. the economic desire to shift higher production demands to the higher capacity and more cost efficient drum mix plants.

All drum mix plants require HMA storage silos to store product ahead of demand. It is estimated that for a maximum production day, a typical drum mix plant will begin production three hours prior to the first truck load-out in order to stay ahead of demand. For days with less than maximum production, a typical drum mix plant will maintain this relative production advantage, although it is not necessary to begin production three hours ahead of the first truck load-out. Since a typical batch mix plant does not have storage for a significant amount of aggregate, it cannot produce significantly ahead of demand. For an eight-hour load-out schedule and equal production capacity, the drum mix plant is able to produce 38 percent more product (11 ÷ 8 = 1.38) than a batch mix plant. It also is estimated that for about 30 minutes over the eight hour day, a typical batch mix plant will need to stop production because there are no transport trucks to load. As a result, the batch mix plant is only able to produce about 94 percent of its hourly target production (7.5 ÷ 8 = 0.938). As a result, the eight-hour load-out capability for drum mix plants is estimated to be 147 percent of the eight-hour production capacity for batch mix plants (1.38 ÷ 0.938 = 1.47). Since the average production capacity of drum mix plants is 27 percent greater than batch mix plants (272 ÷ 214 = 1.27), the overall eight-hour load-out advantage of the average drum mix plant (as compared to the average batch mix plant) would be 187 percent of the eight-hour production capacity (1.47 x 1.27 = 1.87). Using this estimate, if 517 million tons of HMA are produced per year by the 2,300 batch and 1,300 drum-mix plants then:

$$517 \times 10^6 = 2{,}300 \times B + 1{,}300 \times D$$

and

$$D = 1.87 \times B$$

where:

B = average production of a batch mix plant (tons/yr)

and

D = average production of a drum-mix plant (tons/yr)

Solving the equations for B:

$$517 \times 10^6 = 2{,}300 \times B + 1{,}300\ (1.87 \times B)$$
$$517 \times 10^6 = 4{,}731 \times B$$
$$B = 109{,}000 \text{ tons/yr}$$
$$D = 204{,}000 \text{ tons/yr}$$

Using these average production rates, the total 1996 HMA production from batch and drum-mix plants is estimated at about 251 million tons and 265 million tons, respectively.

The Department of Energy indicates that annual distillate fuel sales to industrial customers in the United States for 1998 was 2,462,355,000 gallons (http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/fuel_oil_and_kerosene_sales/current/pdf/table1.pdf) compared to natural gas sales of 8,686,147,000,000 cubic feet (http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/natural_gas_annual/current/pdf/table_014.pdf). At a typical energy content of 140,000 Btu/gal for distillate oil and 1,050 btu/ft3 for natural gas, 96.3 percent of the energy used by industries was natural gas. We expect that many of the factors that promote the preferential use of gas fuels are common within many industries. Therefore, we expect fuel usage at hot mix asphalt plants to be very similar to other industrial sources. Some of these factors are fuel cost, delivery system requirements, and equipment maintenance requirements. The Energy Information Agency reported in the Manufacturing Consumption of Energy 1994 (Combined Consumption and Fuel Switching) report (http://www.eia.doe.gov/emeu/mecs/mecs94/consumption/mecs4a.html) that the national average cost industry paid for 1 million Btu of energy was $2.15 for natural gas, $4.84 for distillate oil and $4.71 for LPG. This report also separates these energy costs by four regions of the United States. Of the four regions, the differences in the costs of the various fuels are smallest in the northeast region. In this region, the average fuel costs were $3.39 for natural gas, $4.89 for distillate oil and $5.69 for LPG. In addition, the delivery of fuel oil and LPG must be scheduled and stored near the production unit. The storage tanks and supporting mechanical equipment require monitoring and maintenance that is not required when the plant is fueled with natural gas. Also, burners for firing fuel oil require a higher level of maintenance than natural gas burners. Lastly, it is recognized that the combustion of fuel oil produces more air emissions than natural gas combustion. Therefore, it is believed that, where it is available, natural gas is and will remain the predominant fuel used at HMA plants. However, many plants will maintain the capability to use fuel oil as an alternate or supplementary fuel. A few plants will use only fuel oil due to the unavailability or high local cost of natural gas. As a spot check of the DOE information on industrial fuel usage, an informal telephone survey of five States was conducted. The survey confirmed that HMA plants use natural gas when it is available. The fuel usage information in the States' emission inventories shows a range of about 50 percent to 99 percent gas usage. However, the fuel usage information reported by industry generally was incomplete. Also, for some States, energy usage per ton of product was over 50 percent higher than emission tests where fuel usage and production information was available. As a result, it is estimated that between 70 and 90 percent of HMA is produced with gas fuels.

2.2 PROCESS DESCRIPTION[1-3]

2.2.1 Batch Mix Plants

Figure 2-1 shows the batch mix HMA production process. Raw aggregate normally is stockpiled near the production unit. The bulk aggregate moisture content typically stabilizes between 3 to 5 percent by weight.

Processing begins as the aggregate is hauled from the storage piles and is placed in the appropriate hoppers of the cold feed unit. The material is metered from the hoppers onto a conveyer belt and is transported into a rotary dryer (typically gas- or oil-fired). Dryers are equipped with flights designed to shower the aggregate inside the drum to promote drying efficiency.

As the hot aggregate leaves the dryer, it drops into a bucket elevator and is transferred to a set of vibrating screens where it is classified into as many as four different grades (sizes) and dropped into individual "hot" bins according to size. For newer facilities, reclaimed asphalt pavement also may be transferred to a separate heated storage bin. To control aggregate size distribution in the final batch mix, the operator opens various hot bins over a weigh hopper until the desired mix and weight are obtained. Concurrent with the aggregate being weighed, liquid asphalt cement is pumped from a heated storage tank to an asphalt bucket where it is weighed to achieve the desired aggregate-to-asphalt cement ratio in the final mix.

The aggregate from the weigh hopper is dropped into the pugmill (mixer) and dry-mixed for 6 to 10 seconds. The liquid asphalt then is dropped into the pugmill where it is mixed for an additional period of time. For older plants, RAP typically is conveyed directly from storage hoppers to the pug mill, where it is combined with the hot aggregate. Total mixing time usually is less than 60 seconds. Then the hot mix is conveyed to a hot storage silo or dropped directly into a truck and hauled to the job site.

2.2.2 Parallel Flow Drum Mix Plants

Figure 2-2 shows the parallel flow drum-mix process. This process is a continuous mixing type process using proportioning cold feed controls for the process materials. The major difference between this process and the batch process is that the dryer is used not only to dry the material but also to mix the heated and dried aggregates with the liquid asphalt cement. Aggregate, which has been proportioned by gradations, is introduced to the drum at the burner end. As the drum rotates, the aggregates as well as the combustion products move toward the other end of the drum in parallel. Liquid asphalt cement flow is controlled by a variable flow pump which is electronically linked to the virgin aggregate and RAP weigh scales. The asphalt cement is introduced in the mixing zone midway down the drum in a lower temperature zone along with any RAP and particulate matter from collectors.

The mixture is discharged at the end of the drum and conveyed to a surge bin or HMA storage silos. The exhaust gases also exit the end of the drum and pass on to the collection system.

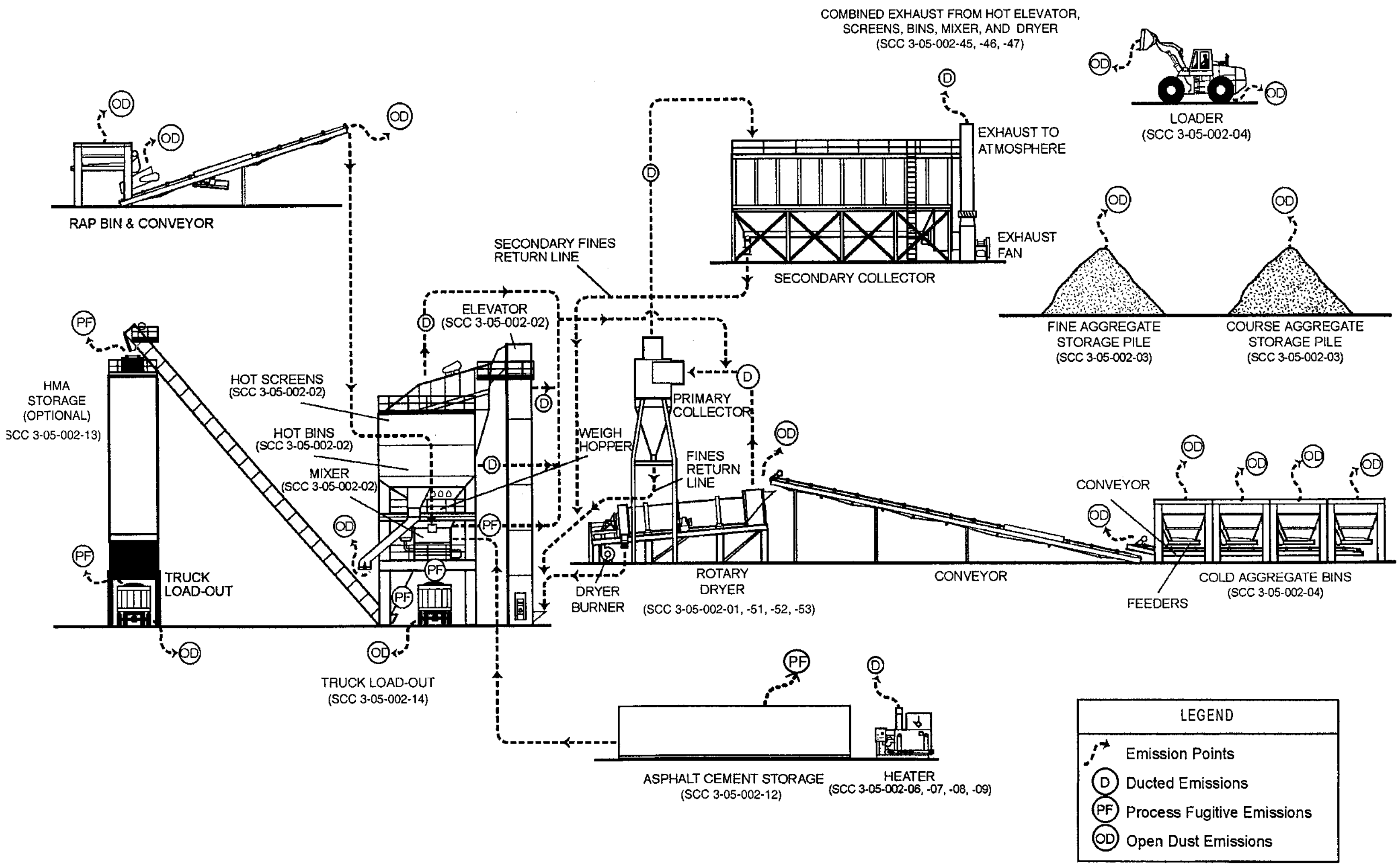

Figure 2-1. General process flow diagram for batch mix asphalt plants (source classification codes in parentheses).[3]

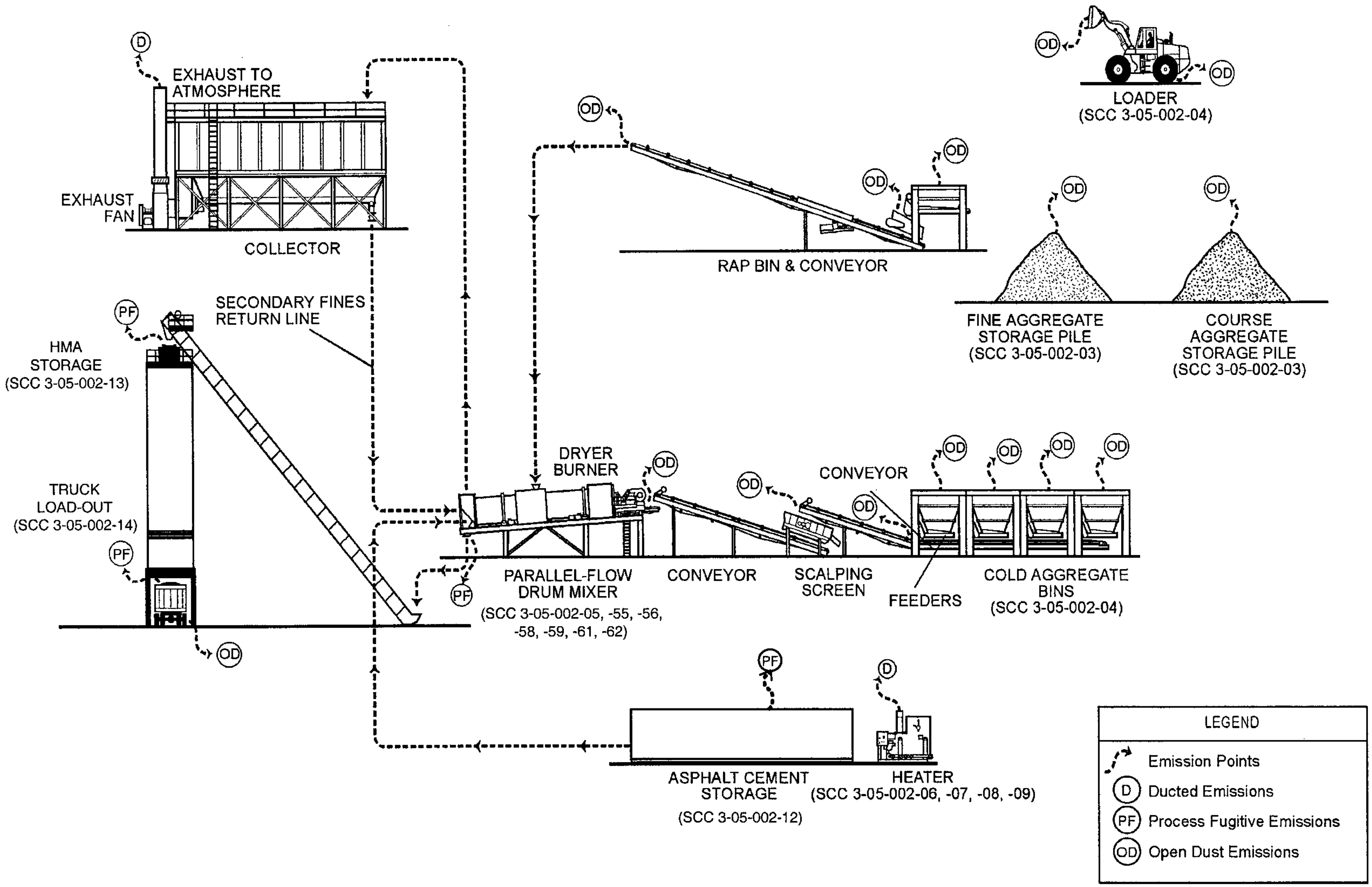

Figure 2-2. General process flow diagram for parallel-flow drum mix asphalt plants (source classification codes in parentheses).[3]

Parallel flow drum mixers have an advantage in that mixing in the discharge end of the drum captures a substantial portion of the aggregate dust, therefore lowering the load on the downstream collection equipment. For this reason, most parallel flow drum mixers are followed only by primary collection equipment (usually a baghouse or venturi scrubber). However, because the mixing of aggregate and liquid asphalt cement occurs in the hot combustion product flow, there is a potential for organic emissions (gaseous and liquid aerosol) to be greater than in counterflow plants and some batch plants. However, this increase in emissions is not evident in the data because variations in the emissions due to other unknown variables are more significant.

2.2.3 Counterflow Drum Mix Plants

Figure 2-3 shows a counterflow drum-mix plant. In this type of plant, the material flow in the drum is opposite or counterflow to the direction of exhaust gases. In addition, the liquid asphalt cement mixing zone is located behind the burner flame zone so as to remove the materials from direct contact with hot exhaust gases.

Liquid asphalt cement flow is controlled by a variable flow pump which is electronically linked to the virgin aggregate and RAP weigh scales. It is injected into the mixing zone along with any RAP and particulate matter from primary and secondary collectors.

Because the liquid asphalt cement, virgin aggregate and RAP are mixed in a zone removed from the exhaust gas stream, counterflow drum-mix plants will likely have organic emissions (gaseous and liquid aerosol) that are lower than parallel flow drum-mix plants. However, the available data are insufficient to discern any differences in emissions that result from differences in the two processes. A counterflow drum-mix plant can normally process RAP at ratios up to 50 percent with little or no observed effect upon emissions.

2.2.4 Recycle Processes

In recent years, the use of RAP has been initiated in the HMA industry. Reclaimed asphalt pavement significantly reduces the amount of new (virgin) rock and asphalt cement needed to produce HMA.

In the reclamation process, old asphalt pavement is removed from the road base. This material is then transported to the plant, and is crushed and screened to the appropriate size for further processing. The paving material is then heated and mixed with new aggregate (if applicable), and the proper amount of new asphalt cement is added to produce HMA that meets the required quality specifications.

2.3 EMISSIONS

Emission points at batch and drum-mix asphalt plants discussed below refer to Figures 2-1, -2, and -3 respectively.

2.3.1 Batch Mix Plants

As with most facilities in the mineral products industry, batch mix HMA plants have two major categories of emissions: ducted sources (those vented to the atmosphere through some type of stack, vent, or pipe), and fugitive sources (those not confined to ducts and vents but emitted directly from the source to the ambient air). Ducted emissions are usually collected and transported by an industrial ventilation system having one or more fans or air movers, eventually to be emitted to the atmosphere through some type of stack. Fugitive emissions result from process and open sources and consist of a combination of gaseous pollutants and PM.

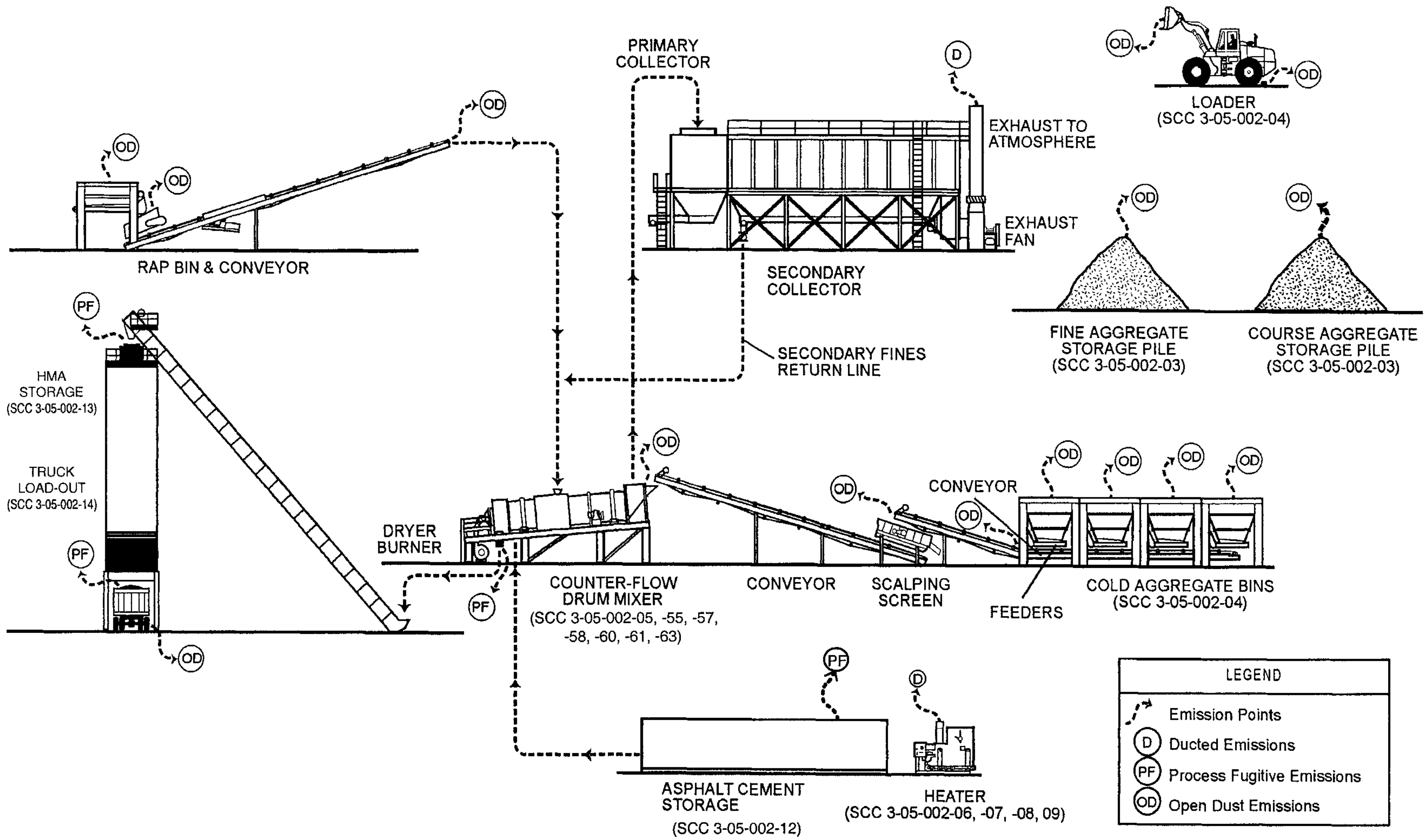

Figure 2-3. General process flow diagram for counter-flow drum mix asphalt plants (source classification codes in parentheses).[3]

The most significant ducted source of emissions from batch mix HMA plants is the rotary drum dryer. Emissions from the drum consist of water (as steam evaporated from the aggregate); PM; products of combustion (carbon dioxide [CO_2], nitrogen oxides [NO_x], and sulfur oxides [SO_x]); carbon monoxide (CO); and small amounts of organic compounds of various species (including volatile organic compounds [VOC], methane [CH_4], and hazardous air pollutants [HAP]). The CO and organic compound emissions result from incomplete combustion of the fuel. It is estimated that about 95 percent of the energy used at HMA plants is from the combustion of natural gas.

Other potential process sources include the hot-side conveying, classifying, and mixing equipment, which are vented to either the primary dust collector (along with the dryer gas) or to a separate dust collection system. The vents and enclosures that collect emissions from these sources are commonly called “fugitive air” or “scavenger” systems. The scavenger system may or may not have its own separate air mover device, depending on the particular facility. The emissions captured and transported by the scavenger system are mostly aggregate dust, but they may also contain gaseous organic compounds and a fine aerosol of condensed organic particles. This organic aerosol is created by the condensation of vapor into particles during cooling of organic vapors volatilized from the asphalt cement in the mixer (pug mill). The amount of organic aerosol produced depends to a large extent on the temperature of the asphalt cement and aggregate entering the pug mill. Organic vapor and its associated aerosol also are emitted directly to the atmosphere as process fugitives during truck load-out, from the bed of the truck itself during transport to the job site, and from the asphalt storage tank. Both the low molecular weight organic compounds and the higher weight organic aerosol contain small amounts of HAP. The ducted emissions from the heated asphalt storage tanks may include gaseous and aerosol organic compounds and combustion products from the tank heater.

There also are a number of fugitive dust sources associated with batch mix HMA plants, including vehicular traffic generating fugitive dust on paved and unpaved roads, aggregate material handling, and other aggregate processing operations. Fugitive dust may range from 0.1 µm to more than 300 µm in aerodynamic diameter. On average, 5 percent of cold aggregate feed is less than 74 µm (minus 200 mesh). Fugitive dust that may escape collection before primary control generally consists of PM with 50 to 70 percent of the total mass less than 74 µm. Uncontrolled PM emission factors for various types of fugitive sources in HMA plants are addressed in Section 13.2.3, “Heavy Construction Operations.”

2.3.2 Parallel Flow Drum Mix Plants

The most significant ducted source of emissions from parallel-flow drum-mix plants is the rotary drum dryer. Emissions from the drum consist of water (as steam evaporated from the aggregate); PM; products of combustion; CO; and small amounts of organic compounds of various species (including VOC, CH_4, and HAP). The organic compound emissions result from incomplete combustion of the fuel and from heating and mixing of the liquid asphalt cement inside the drum. The CO emissions result from incomplete combustion of the fuel. Although it has been suggested that the processing of RAP materials at these type plants may increase organic compound emissions because of an increase in mixing zone temperature during processing, the data supporting this hypothesis are very weak. Specifically, although the data show a relationship only between RAP content and condensable organic particulate emissions, 89 percent of the variations in the data were the result of other unknown process variables.

Once the organic compounds cool after discharge from the process stack, some condense to form a fine organic aerosol or “blue smoke” plume. A number of process modifications or restrictions have been introduced to reduce blue smoke including installation of flame shields, rearrangement of flights inside the drum, adjustments of the asphalt injection point, and other design changes.

2.3.3 Counterflow Drum Mix Plants

The most significant ducted source of emissions from counter-flow drum-mix plants is the rotary drum dryer. Emissions from the drum consist of water (as steam evaporated from the aggregate); PM; products of combustion; CO; and small amounts of organic compounds of various species (including VOC, CH_4, and HAP). The CO and organic compound emissions result primarily from incomplete combustion of the fuel. Because liquid asphalt cement, aggregate, and sometimes RAP, are mixed in a zone not in contact with the hot exhaust gas stream, counterflow drum mix plants will likely have lower organic compound emissions from the kiln stack than parallel flow drum mix plants. However, variations in the emissions due to other unknown process variables are more significant. As a result, the emission factors for parallel flow and counterflow drum mix plants are the same.

2.3.4 Parallel and Counterflow Drum Mix Plants

Process fugitive emissions associated with batch plants from hot screens, elevators and the pugmill are not present in the drum-mix processes. However, there are fugitive PM and VOC emissions from the transport and handling of the HMA from the drum mixer to the storage silo and also from the load out operations to the delivery trucks. Since the drum process is continuous, these plants have surge bins or storage silos. The open dust sources associated with drum-mix plants are similar to those of batch mix plants with regard to truck traffic and aggregate material feed and handling operations.

2.4 CONTROL TECHNOLOGY

The choice of applicable emission controls for PM emissions from the dryer and vent line includes dry mechanical collectors, scrubbers, and fabric filters. Attempts to apply electrostatic precipitators have met with little success. Practically all plants use primary dust collection equipment such as large diameter cyclones, skimmers, or settling chambers. These chambers are often used as classifiers to return collected material to the hot elevator and to combine it with the drier aggregate. To capture remaining PM, the primary collector effluent is ducted to a secondary collection device. Most plants use either a fabric filter or a venturi scrubber for secondary emissions control. As with any combustion process, the design, operation, and maintenance of the burner provides opportunities to minimize emissions of NO_x, CO, and organic compounds.

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5. *A Study Of The Use Of Recycled Paving Material - Report To Congress*, FHWA-RD-93-147, EPA/600/R-93/095, U. S. Department of Transportation and U. S. Environmental Protection Agency, Washington, DC, June 1993.

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3. GENERAL DATA REVIEW AND ANALYSIS PROCEDURES

3.1 LITERATURE SEARCH AND SCREENING

Data for this investigation were obtained from a number of sources within the Office of Air Quality Planning and Standards (OAQPS) and from outside organizations. The AP-42 background files located in the Emission Factor and Inventory Group (EFIG) were reviewed for information on the industry, processes, and emissions. The Factor Information and Retrieval (FIRE) and VOC/PM Speciation Data Base Management System (SPECIATE) data bases were searched by SCC for identification of the potential pollutants emitted and emission factors for those pollutants. A general search of the Air CHIEF CD-ROM also was conducted to supplement the information from these data bases.

Information on the industry, including number of plants, plant location, and annual production capacities, was obtained from the National Asphalt Pavement Association (NAPA) and other sources. The Aerometric Information Retrieval System (AIRS) data base also was searched for data on the number of plants, plant location, and estimated annual emissions of criteria pollutants. A number of sources of information were investigated specifically for emission test reports and data. A search of the Test Method Storage and Retrieval (TSAR) data base was conducted to identify test reports for sources within the hot mix asphalt industry. However, the test reports located using the TSAR data base were already obtained for an earlier revision of this document. A search of EPA's Source Test Information Retrieval System (STIRS) was conducted to identify test reports for the hot mix asphalt industry. Most of the new data obtained for this revision were located in STIRS. Using information obtained on plant locations, individual facilities and State and Regional offices were contacted about the availability of test reports. Publications lists from the Office of Research and Development (ORD) and Control Technology Center (CTC) also were searched for reports on emissions from the hot mix asphalt industry. In addition, representative trade associations, including NAPA, were contacted for assistance in obtaining information about the industry and emissions.

To screen out unusable test reports, documents, and information from which emission factors could not be developed, the following general criteria were used:

1. Emission data must be from a primary reference:

a. Source testing must be from a referenced study that does not reiterate information from previous studies.

b. The document must constitute the original source of test data. For example, a technical paper was not included if the original study was contained in the previous document. If the exact source of the data could not be determined, the document was eliminated.

2. The referenced study should contain test results based on more than one test run. If results from only one run are presented, the emission factors must be down rated.

3. The report must contain sufficient data to evaluate the testing procedures and source operating conditions (e.g., one-page reports generally were rejected).

A final set of reference materials was compiled after a thorough review of the pertinent reports, documents, and information according to these criteria.

3.2 EMISSION DATA QUALITY RATING SYSTEM

The quantity and quality of the information contained in the final set of reference documents were evaluated. The following data were excluded from consideration.

1. Test series averages reported in units that cannot be converted to the selected reporting units;

2. Test series representing incompatible test methods (e.g., comparison of the EPA Method 5 front-half with the EPA Method 5 front- and back-half);

3. Test series of controlled emissions for which the control device is not specified;

4. Test series in which the source process is not clearly identified and described; and

5. Test series in which it is not clear whether the emissions were measured before or after the control device.

Data sets that were not excluded were assigned a quality rating. The rating system used was that specified by OAQPS for the preparation of AP-42 sections. The data were rated as follows:

A–Multiple tests performed on the same source using sound methodology and reported in enough detail for adequate validation. These tests do not necessarily conform to the methodology specified in the EPA Reference Methods, although these methods were certainly used as a guide for the methodology actually used.

B–Tests that were performed by a generally sound methodology but lack enough detail for adequate validation.

C–Tests that were based on an untested or new methodology or that lacked a significant amount of background data.

D–Tests that were based on a generally unacceptable method but may provide an order-of-magnitude value for the source.

The following criteria were used to evaluate source test reports for sound methodology and adequate detail:

1. <u>Source operation</u>. The manner in which the source was operated is well documented in the report. The source was operating within typical parameters during the test.

2. <u>Sampling procedures</u>. The sampling procedures conformed to a generally acceptable methodology. If actual procedures deviated from accepted methods, the deviations are well documented. When this occurred, an evaluation was made of the extent to which such alternative procedures could influence the test results.

3. <u>Sampling and process data</u>. Adequate sampling and process data are documented in the report. Many variations can occur unnoticed and without warning during testing. Such variations can induce wide deviations in sampling results. If a large spread between test results cannot be explained by information contained in the test report, the data are suspect and were given a lower rating.

4. Analysis and calculations. The test reports contain original raw data sheets. The nomenclature and equations used were compared to those (if any) specified by the EPA to establish equivalency. The depth of review of the calculations was dictated by the reviewer's confidence in the ability and conscientiousness of the tester, which in turn was based on factors such as consistency of results and completeness of other areas of the test report.

3.3 EMISSION FACTOR QUALITY RATING SYSTEM

The quality of the emission factors developed from analysis of the test data was rated utilizing the following general criteria:

A–Excellent: Developed primarily from A- and B-rated test data taken from many randomly chosen facilities in the industry population. The source category is specific enough that variability within the source category population may be minimized.

B–Above average: Developed primarily from A- and B-rated test data from a moderate number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As in the A-rating, the source category is specific enough so that variability within the source category population may be minimized.

C–Average: Developed primarily from A-, B-, and C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As in the A-rating, the source category is specific enough so that variability within the source category population may be minimized.

D–Below average: The emission factor was developed primarily from A-, B-, and C-rated test data from a small number of facilities, and there is reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of the emission factor are noted in the emission factor table.

E–Poor: The emission factor was developed from C- and D-rated test data, and there is reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of these factors are always noted.

The use of these criteria is somewhat subjective and depends to an extent on the individual reviewer.

REFERENCE FOR SECTION 3

1. *Procedures For Preparing Emission Factor Documents*, EPA-454/R-95-015. U. S. Environmental Protection Agency, Research Triangle Park, NC, 27711, May 1997.

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4. AP-42 SECTION DEVELOPMENT

4.1 REVISION OF SECTION NARRATIVE

The AP-42 section is a revision of a previously developed draft. The section that currently is published in AP-42 has been updated to include large amounts of additional test data gathered following publication of the fifth edition of AP-42. Valid data from the old and new references were combined (where applicable) to develop emission factors for several pollutants, including filterable particulate matter (PM), condensable organic PM, condensable inorganic PM, carbon monoxide (CO), carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen oxides (NO_X), metals, total organic compounds (TOC), volatile organic compounds (VOC), methane, benzene, toluene, ethylbenzene, xylene, polynuclear aromatic hydrocarbons (PAH), aldehydes, polychlorinated dibenzofurans (PCDF), and polychlorinated dibenzo(p)dioxins (PCDD) emitted from hot mix asphalt (HMA) production operations. These emission factors represent emissions from drum-mix and batch-mix dryers fired by natural gas, propane, fuel oil (Nos. 2, 4, 5, or 6), and waste oil. Additional emission factors were developed for emissions from hot oil heaters. No emission factors for conventional continuous plants are included in the revised section because these plants represent a small percentage of the industry (less than one-half of 1 percent).

Another major revision to the section involves the inclusion of emission factors and emission factor equations for HMA load-out operations. These emission factors and equations were developed using data from a recent EPA testing program. Their development is described in Section 4.4 of this background report.

4.2 POLLUTANT EMISSION FACTOR DEVELOPMENT

More than 300 emission test reports were obtained for use in developing new emission factors for HMA production. Twenty-seven of these reports, as shown in Table 4-1, were rejected for use in developing emission factors. All of the references used for developing emission factors are discussed in the following paragraphs. Brief reviews of the first 23 references also are provided, although many of these references were not used for emission factor development.

4.2.1 <u>Review of Specific Data Sets</u>

4.2.1.1 <u>Reference 1</u>. This document contains a description of conventional HMA production operations and presents emission data from 45 HMA plants. Average emission factors were developed for conventional (continuous and batch mix) dryers controlled by spray towers, centrifugal scrubbers, and fabric filters. In addition, the results of an emission study conducted at five HMA plants are presented. The five source test reports are located in the background file. During the study, dryer stack emissions were measured simultaneously with an EPA source sampling train and a Los Angeles source sampling train. The Los Angeles train measured 37 percent higher PM emissions than the EPA train when emissions were sampled following fabric filtration and 20 percent lower PM emissions following wet scrubber systems. Particle size data contained in this document were evaluated in Reference 23 and are not discussed here.

The data from the industry survey were assigned a C rating because the production rates were estimated from the plant capacities and the test data sheets for each test were not provided. The data from three of the five emission tests (EPA sampling train only) conducted as a part of this study were assigned a C rating because the types of plants were not specified and only two test runs were performed during each test. The plants were the conventional type, but batch or continuous operations were not specified. The data for plant No. 1 were not considered valid because problems with the fabric filter were reported during testing, and the emissions were considerably higher than emissions from the other plants tested. The data for plant No. 3 were not considered valid because problems with cyclonic flow were experienced during testing.

4.2.1.2 Reference 2. This document contains information on process operations and control systems for the HMA industry. No emission data for use in developing emission factors were presented.

4.2.1.3 Reference 3. This document presents test data from 25 tests conducted at conventional HMA plants by Los Angeles County Air Pollution Control District personnel prior to 1960. Filterable PM emissions and particle size distribution are included in the data summary. A telephone conversation documented in Reference 23 of this AP-42 background file indicated that the PM sampling train was similar to the EPA Method 5 train, except that the filter was located downstream of the impingers. A "Micromerograph" was used to determine particle size. The data were gathered more than 30 years ago and cannot be validated because little detail about the testing is provided. Therefore, the data were not rated and were not used for emission factor development.

4.2.1.4 Reference 4. This document contains a description of HMA production operations and potential control systems. Some emission data are included in the document, but no production rates are documented. The data presented are the same data presented in Reference 3. Therefore, the data were not rated and were not used for emission factor development.

4.2.1.5 Reference 5. This document is an excerpt from the 1973 edition of the Air Pollution Engineering Manual. Data for filterable PM emissions and particle size distribution from two HMA batching plants are presented, but no indication of the number of test runs performed or the test method used is provided. In addition, control devices are not specified. However, the magnitude of the emissions suggests that the emissions were uncontrolled. Filterable PM and size-specific PM emission factors were developed for batch-mix dryers.

All of the data were assigned a D rating because insufficient detail was provided for validation of the emission tests.

4.2.1.6 Reference 6. This document presents emission data from 19 emission tests at 10 HMA batching plants. Data for PM emissions from dryers are presented, but no indication of the number of test runs performed or the test method used is provided. The data were gathered more than 40 years ago and cannot be validated because little detail about the testing is provided. Therefore, the data were not rated and were not used for emission factor development.

4.2.1.7 Reference 7. This document includes a process description for HMA batching plants, control efficiencies for various control devices, and limited emission data. No indication is given of the number of test runs performed or the test method used to quantify emissions. The data were gathered more than 30 years ago and cannot be validated because little detail about the testing is provided. Therefore, the data were not rated and were not used for emission factor development.

4.2.1.8 Reference 8. This document is not located in the background file.

4.2.1.9 Reference 9. This document is the same as Reference 3, which is described in Section 4.2.3.3.

4.2.1.10 Reference 10. This document presents costs and efficiencies for control devices used at HMA batching plants but does not contain emission data that can be used for emission factor development.

4.2.1.11 Reference 11. This document contains a description of the drum-mix HMA production process and contains secondary emission data for total PM emissions from drum mixers with various controls. Several deficiencies are noted in the text, including a lack of detail on the control systems and a large variation in emission concentrations. In addition, run-by-run data are not presented. For these reasons, the data presented were assigned a D rating.

4.2.1.12 Reference 12. This document describes in detail the drum-mix process but does not contain any emission data that were used for emission factor development.

4.2.1.13 Reference 13. This document describes the drum-mix process and contains limited emission data. No indication is given of the number of test runs performed or the test method used to quantify emissions. In addition, uncontrolled PM emission factors calculated from two of the tests differ by an order of magnitude. The data presented were not rated and were not used for emission factor development.

4.2.1.14 Reference 14. This document describes the production of HMA and discusses proposed (1973) new source performance standards (NSPS) for the industry but does not contain any emission data that were suitable for emission factor development.

4.2.1.15 Reference 15. This document presents the final version of Reference 14. Data from 8 of the 18 tests were used for emission factor development. Data were not used if (1) no production rates were documented; (2) only 1 test run was performed; or (3) the data were deemed invalid because of problems encountered during testing. Data for filterable PM, total PM, condensable inorganic PM, and CO_2 emissions from batch mix plants with various control systems were presented.

The data were assigned a B rating because the document is a secondary reference and does not contain sufficient detail about the processes and tests. Usually, data from a secondary reference are assigned a C rating. However, these data were used for the development of an NSPS and were the focus of scrutiny by the HMA industry, the technical staff developing the regulation, and public interest groups. Therefore, the data rating was increased by one level. If only two valid test runs were performed, the data were assigned a C rating. The testing methodologies appeared to be sound, and no problems were reported during the valid test runs.

4.2.1.16 Reference 16. This document contains secondary emission data from several sources. In addition, the results of an industrial survey are presented. The survey was conducted in 1975 by Monsanto Research Corporation. Data for uncontrolled and controlled PM emissions from drum mixers were documented, but sufficient detail were not included for validation of the data.

4.2.1.17 Reference 17. This document presents the results of two test programs conducted at HMA plants. Both plants tested were batch mix plants with wet scrubbers controlling dryer emissions. Some run-by-run data are presented, but the run-by-run emission rates are not included in the document. The data presented could not be used for emission factor development.

4.2.1.18 Reference 18. This document does not contain data or process information that is relevant to this section. The revised AP-42 section does not reference this document.

4.2.1.19 Reference 19. This document does not contain data or process information that is relevant to this section. The revised AP-42 section does not reference this document.

4.2.1.20 Reference 20. This reference is missing from the background file.

4.2.1.21 Reference 21. This document discusses the application of fabric filters to dryers at HMA plants. Some emission data also are presented, but they are insufficient for use in developing emission factors.

4.2.1.22 Reference 22. This document presents the results of VOC emission tests conducted at five drum-mix HMA plants. Method 25 was used to quantify nonmethane VOC (as carbon) emissions, which are referred to as total nonmethane organic compounds (TNMOC) in Section 4.2.4 of this report. In addition, PM emissions were measured (Method 5) at one of the plants. Operating parameters were varied from run to run, but no change in emissions (attributable to a specific variation) was noticeable.

The data from this document were assigned a D rating. Adequate detail about the processes and tests was provided, and no problems were reported during testing. However, the data were downgraded to D because a positive bias in Method 25 results may occur when the product of the moisture content and CO_2 concentration of the stack gas is greater than 100, which is typical of stack gas from HMA plants (moisture contents and CO_2 concentrations were not provided in the document). Also, complete run-by-run emission data were not provided, and the actual emission test reports were not available for review.

4.2.1.23 Reference 23. This document presents the background information used for the 1986 revision of AP-42 Section 8.1, Asphaltic Concrete Plants. The main emphasis in the 1986 revision was size-specific PM, and only primary references that contained particle size data were used for emission factor development in the report. Data from six references were used to develop size-specific PM emission factors. Because of a lack of available data, several data sets that would not usually be used for AP-42 emission factor development were used. For this document and the associated AP-42 revision, the suspect data sets were not used for emission factor development unless no new data were available for similar source/control combinations.

Four of the six data sets are considered to be of insufficient quality for inclusion in the revised AP-42 section. Two of the data sets are based on testing using cascade impactors that, based on the dates of the tests, probably used “button hook” preseparators rather than cyclones. There is potential for inaccuracies in particle size distribution measured with this type of impactor. Two of the data sets are based on emission testing conducted before 1970 and are considered to be outdated. The particle size data for uncontrolled batch-mix dryers from this document were retained in the AP-42 section because no new data are available for uncontrolled batch-mix dryers. These data are assigned a D rating and are not of the quality desired for use in AP-42. The two valid data sets are described below (excerpts from Reference 23 are shown in italics). It should be noted that the data from Reference 26 (transcribed below in italics) are now assigned a C rating because only one test run was performed.

(EXCERPT FROM REFERENCE 23)

3.4.7 Reference 26 [H.J. Taback, et al., Fine Particle Emissions from Stationary and Miscellaneous Sources in the South Coast Air Basin, KVB 5806-783, KVB, Inc., Tustin, CA, February 1979.]

Reference 26 is a study of the fine particle emissions from a variety of sources in the South Coast Air Basin (Los Angeles), conducted by a contractor to the California Air Resources Board (CARB). One test included in this study was of the emissions from an asphalt batch plant controlled by a cyclone collector followed by a baghouse. Only one test run was performed during the sampling program with concurrent measurements made at the inlet and outlet of the baghouse collector.

The size distribution of the particulate was determined at each sampling location using either of two sampling trains equipped with a series of three individual cyclones having nominal cut-points of 10, 3, and 1 µmA, respectively. For inlet testing, a standard EPA Method 5 (Joy) train was adapted for the program by installing the three cyclones and a backup filter in the oven section of the impinger box. For testing at the outlet, the Source Assessment Sampling System (SASS) was used. The data obtained from the CARB study were entered into the EADS system from which a printout was obtained. A summary of the data contained in Reference 26 is provided in Table 3-11 with a copy of the pertinent sections of the draft report included in Appendix F. Upon checking with the contractor it was learned that the test data for run 29S were not changed in the final report from that included in the draft shown in Appendix F.[48]

TABLE 3-11. SUMMARY OF PARTICLE SIZE DATA FOR REFERENCE 26[a]

Data Rating: B

Test No.	Sampling location[b]	Percent of particles in stated size range[c] >10 µmA	10-3 µmA	3-1 µmA	<1 µmA
29S	Outlet	60	6	4	30

[a]*From page 4-165 of Reference 26 (Appendix F).*
[b]*Location relative to baghouse collector.*
[c]*Aerodynamic diameter.*

From the analysis of Reference 26 it was determined that the particle size measurements were made during sound methodology, and it does contain adequate information for validation. The only significant problem found with the data was that the cyclone train at the inlet to the baghouse became overloaded with material, which could significantly affect the validity of the test results. This fact was learned from a review of the test report itself rather than from the EADS printout. For this reason, the data collected at the inlet of the baghouse were not used in the development of candidate emission factors. Since only one test run was conducted at the outlet of the baghouse, a rating of B was assigned to the data.

3.4.8 Reference 27 [T.J. Walker, et al., Characterization of Inhalable Particulate Matter Emissions from a Drum-Mix Asphalt Plant, EPA Contract No. 68-02-3158, Technical Directive 8, Midwest Research Institute, Kansas City, MO, February 1983.]

Reference 27 is a report of the tests conducted by MRI, under the IP program, of a drum-mix asphalt plant controlled by a baghouse collector. The drum mixer was equipped to process recycled asphalt paving utilizing a split feed arrangement. Particulate matter contained in the exhaust stream was sampled at both the inlet and outlet of the baghouse with measurements also made of the condensation aerosol which would theoretically be formed upon release into the atmosphere (condensable organics).

The general sampling protocol used in this study was that developed for the IP program.[35] At the inlet, the total uncontrolled emissions from the process were determined from a six-point traverse utilizing EPA Method 5. The particle size distribution was obtained from samples collected by an Andersen High Capacity Stack Sampler equipped with a Sierra Instruments 15-µmA preseparator. Four particle size tests were conducted at each of the four sampling quadrants for a total of 16 test runs.

At the outlet from the baghouse, the total mass emissions from the plant were determined utilizing proposed EPA Method 17, with two tests being conducted at each of four sampling quadrants. The particle size distribution was likewise obtained using an Andersen mark III cascade impactor and Sierra Instruments 15 µmA preseparator utilizing an identical test protocol.

Condensable organics testing was also performed during the study utilizing the Dilution Stack Sampling System (DSSS) developed by Southern Research Institute.[49] This system extracts a small slipstream of gas from the stack which, after removing particles >2.5 µmA in diameter, is mixed in a dilution chamber with cool, dry ambient air. A standard high-volume air sampler is installed at the discharge end of the chamber which collects a combination of the fine particulate (<2.5 µm) extracted from the stack and any new particulate matter formed by condensation. The loadings obtained from the DSSS are then compared to those measured by a second sampling train without the dilution chamber to determine the amount of condensable organics formed. Three separate tests were conducted at the outlet of the baghouse collector during the sampling program.

Table 3-12 through 3-14 provides a summary of the results of this study with a copy of applicable portions of the document included in Appendix G.

Since the tests in Reference 27 were conducted according to the protocol developed for the IP program and are well documented, a rating of A was assigned to the data.

(EXCERPT FROM REFERENCE 23)

Table 3-12. SUMMARY OF PARTICLE SIZE TEST DATA COLLECTED AT THE BAGHOUSE INLET – REFERENCE 27[a]

Data Rating: A

		15 µm Cyclone			Stage 1			Stage 2			Cyclone			Filter	
Test No.	Run No. (source-run-quad)	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)
1	1-1-1(B)	4,775.2	14.8	30.2	95.2	11.4	28.8	617.5	6.3	19.7	1,091.0	1.9	3.8	258.0	<1.9
	1-1-2	6,088.7	15.5	25.0	125.0	11.8	23.5	566.6	6.7	16.5	1,143.3	1.9	2.4	198.0	<1.9
	1-1-3	6,345.5	15.1	19.2	68.5	11.5	18.3	399.4	6.5	13.3	906.8	1.9	1.7	134.3	<1.9
	1-1-4	10,607.6	15.2	17.6	179.5	11.6	16.2	750.9	6.5	10.4	977.9	1.9	2.8	356.5	<1.9
2	1-2-1(C)[b]	212.91	14.5	26.7	45.6	11.2	25.1	221.8	6.2	17.5	446.3	1.8	2.1	60.8	<1.8
	1-2-2(B)	5,881.3	15.6	25.7	127.0	11.7	24.1	621.1	6.6	16.2	1,061.0	2.0	2.8	222.6	<2.0
	1-2-3	4,157.7	15.4	22.9	60.4	11.7	21.7	362.7	6.6	15.0	746.0	1.9	1.2	62.4	<1.9
	1-2-4	9,068.9	15.0	22.9	406.6	11.5	19.5	767.3	6.4	12.9	1,038.8	1.9	4.1	481.7	<1.9
3	1-3-1	5,718.0	15.7	22.3	364.8	11.7	17.4	200.5	6.6	14.7	975.1	2.0	1.4	104.1	<2.0
	1-3-2	6,113.0	15.5	23.5	81.0	11.7	22.5	505.7	6.6	16.2	997.5	2.0	3.7	294.8	<2.0
	1-3-3	3,086.1	15.4	33.5	62.2	11.6	32.1	393.8	6.5	23.6	937.4	1.9	3.4	159.4	<1.9
	1-3-4	10,346.7	15.2	19.8	170.5	11.6	18.5	888.7	6.5	11.6	1,062.2	1.9	3.4	435.3	<1.9
4	1-4-1	2,149.4	15.5	35.8	48.4	11.7	34.4	301.8	6.61	25.4	671.9	2.0	5.3	177.1	<2.0
	1-4-2	3,242.0	15.4	27.8	78.4	11.7	26.00	348.8	6.6	18.2	642.8	1.9	3.9	175.2	<1.9
	1-4-3	7,794.4	15.4	20.2	89.3	11.6	19.3	550.6	6.6	13.6	874.2	1.9	4.7	456.6	<1.9
	1-4-4	9,585.9	15.5	21.4	178.5	11.7	20.0	873.4	6.6	12.8	785.0	2.0	6.4	777.3	<2.0

[a] *Reproduced from Table 4.4, p. 49 of Reference 27 (Appendix G).*
[b] *Test conducted during the processing of recycled asphalt paving.*

(EXCERPT FROM REFERENCE 23)

Table 3-13. SUMMARY OF PARTICLE SIZE TEST DATA COLLECTED AT THE BAGHOUSE INLET – REFERENCE 27[a]

Data Rating: A

		15-µm Cyclone			Stage 0			Stage 1			Stage 2			Stage 3		
Test No.	Run No. (source-run -quad)	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size
1	0-1-1(B)	37.96	14.9	42.1	0.41	14.7	41.5	1.34	9.1	39.5	3.65	6.2	33.9	5.30	4.2	25.8
	0-1-2[b]	84.91	14.7	21.0	0.51	14.4	20.1	0.89	9.0	19.7	3.94	6.1	16.0	4.44	4.1	11.9
	0-1-3[b]	39.29	14.9	26.0	0.00	14.6	26.0	0.63	9.1	24.8	1.95	6.1	21.1	2.82	4.2	15.8
	0-1-4	72.37	14.8	31.6	0.61	14.7	31.1	0.73	9.2	30.4	2.36	6.2	28.1	16.29	4.2	12.7
2	0-2-1	21.93	15.2	56.7	1.60	14.9	53.1	1.88	9.3	49.8	4.33	6.3	41.2	4.56	4.3	32.2
	0-2-2	49.78	15.0	35.7	0.67	14.7	34.9	0.85	9.2	33.8	3.36	6.2	29.4	4.33	4.2	23.8
	0-2-3	61.54	14.6	32.8	3.52	14.3	28.9	1.98	8.9	26.8	4.77	6.0	21.6	4.58	4.1	16.6
	0-2-4	71.68	15.4	37.0	7.79	15.0	30.1	3.38	9.4	27.2	5.75	6.3	22.1	6.57	4.3	16.3

		Stage 4			Stage 5			Stage 6			Stage 7			Filter	
Test No.	Run No. (source-run -quad)	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)	Cum. % less than stated size	Mass (mg)	D_{50} size (µm)
1	0-1-1(B)	8.45	2.7	12.9	5.71	1.3	4.2	2.07	0.80	1.1	0.33	0.59	0.56	0.37	<0.59
	0-1-2[b]	5.43	2.6	6.8	4.74	1.3	2.4	1.71	0.78	0.82	0.57	0.58	0.29	0.31	<0.58
	0-1-3[b]	2.97	2.7	10.2	3.26	1.3	4.1	1.81	0.79	0.64	0.21	0.58	0.24	0.13	<0.58
	0-1-4	0.00	2.7	12.7	12.4	1.3	1.0	0.00	0.81	1.0	0.88	0.59	0.20	0.21	<0.59
2	0-2-1	5.68	2.7	21.0	5.09	1.3	11.0	2.60	0.81	5.8	1.54	0.60	2.8	1.40	<0.60
	0-2-2	7.91	2.7	33.6	6.63	1.3	5.1	2.95	0.80	1.3	0.77	0.59	0.26	0.20	<0.59
	0-2-3	7.04	2.6	8.9	5.09	1.3	3.3	2.45	0.78	0.64	0.46	0.57	0.14	0.13	<0.57
	0-2-4	8.35	2.8	9.0	6.07	1.4	3.7	2.52	0.82	1.4	0.91	0.61	0.63	0.72	<0.61

[a] *Reproduced from Table 4.5, p. 50 of Reference 27 (Appendix G).*
[b] *Test conducted during the processing of ~30% recycled asphalt paving.*

4.2.1.24 Reference 24. The plant tested was a batch mix facility with a natural gas-fired dryer and emissions controlled by a fabric filter. The test included controlled measurements of filterable PM, size-specific PM, trace metals, and PAH emissions and uncontrolled measurements of CO, CO_2, SO_2, NO_x, aldehydes, methane, benzene, toluene, ethylbenzene, xylene, and TOC emissions. All of the tests were performed at the outlet of the fabric filter on the dryer, but fabric filters provide only incidental, if any, control of the above pollutants that are labeled as uncontrolled. Several target pollutants were not detected in any run. Particulate matter and trace metal emissions were sampled using EPA Method 5/Combined Train SW 846 Test Method 0031. Size-specific PM, condensable inorganic PM, and condensable organic PM emissions were determined using EPA Methods 201A and 202. However, the actual cut size for the PM-10 catch was 7.9 micrometers (µm) because the test ports were not large enough to allow the proper nozzle to be used. Measurements of CO, CO_2, SO_2, and NO_x were taken using continuous emissions monitoring systems (CEMS) following EPA Methods 10, 3A, 6C, and 7E, respectively. Sampling for PAHs was performed concurrently with the PM and metals test by EPA SW 846 Test Method 0010 (Semi-VOST), and aldehyde sampling was done using EPA SW 846 Method 0011. Methane, benzene, toluene, ethylbenzene, and xylene emissions were determined using EPA Method 18 (13 samples analyzed for each pollutant), and TOC emissions were measured using EPA Method 25A (CEMS). The Method 25A results were converted to TOC as methane using the measured emission concentration, the density of methane at standard temperature and pressure (STP), and the volumetric flow rate for each test run. Three test runs were performed for each pollutant measured, except for the pollutants measured by CEMS, as well as methane, benzene, toluene, ethylbenzene, and xylene. The results from the CEMS were averaged over the duration of each test run, thus giving one value for each pollutant from each of three test runs. The second metals run was not included in the development of emission factors because the back-half sample bottle was broken during shipment. The emission factors developed from this test report differ from the emission factors presented in the test report because of the treatment of runs in which the pollutant concentration was found to be below the detection limit. In the test report, runs of this type were not included in emission averages, whereas the emission factors developed from the report use one-half of the detection limit as the emissions from a "nondetect" run. Detection limits were not provided for benzene, toluene, ethylbenzene, and xylene. For these pollutants, assumed detection limits were calculated using 80 percent of the smallest detected amount of each pollutant.

A rating of A was assigned to most of the test data, unless more than one test run did not detect the targeted pollutant, in which case the data were assigned a B rating. Methane, benzene, toluene, ethylbenzene, and xylene emission data were assigned a B rating because detection limits were not provided. Data for PM-10 emissions were assigned a C rating because of the problem with the actual cut size (see above) as well as the use of an average volumetric flow rate for calculating emission rates (measured rates were suspect). Data for condensable PM emissions were assigned a B rating because of the use of an average volumetric flow rate for calculating emission rates (measured rates were suspect). The acetone data are assigned a D rating because a high field blank indicates possible sample contamination. Otherwise, the report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.25 Reference 25. The plant tested was a drum-mix facility with a waste oil-fired dryer and emissions controlled by a fabric filter. The test included controlled measurements of filterable PM, condensable inorganic PM, condensable organic PM, PM-10, trace metals, and PAHs from the plant stack (drum mixer/dryer fabric-filter outlet). Uncontrolled measurements included CO, CO_2, NO_x, SO_2, aldehydes, methane, benzene, ethylbenzene, toluene, xylene, and TOC emissions from the plant stack. All of the tests were performed at the outlet of the fabric filter, but fabric filters provide only incidental, if any, control of the above pollutants that are labeled as uncontrolled. Filterable PM and trace metal emissions were sampled using EPA Method 5/Combined Train SW 846 Test Method 0031. Size-specific PM and condensable PM emissions were determined using EPA Methods 201A and 202. Measurements of CO, CO_2, NO_X, SO_2, and TOC were taken using a CEMS following EPA Methods 10, 3A, 7E, 6C, and 25A, respectively. The Method 25A results were converted to TOC as methane using the measured emission concentration, the density of methane at STP, and the volumetric flow rate for each test run. Sampling for PAHs was performed concurrently with the PM and metals test using EPA SW 846 Test Method 0010 (Semi-VOST), and aldehyde sampling was done using EPA SW 846 Method 0011. Methane, benzene, toluene, ethylbenzene, and xylene emissions were determined using EPA Method 18. Three test runs were performed for each pollutant measured, except for the pollutants measured by CEMS. The results from the CEMS were averaged over the duration of each test run, thus giving one value for each pollutant from each of three test runs. The emission factors developed using the data from this test report differ from the emission factors presented in the test report because of the treatment of runs in which the pollutant concentration was found to be below the detection limit. In the test report, runs of this type were included in emission averages (zero emissions), whereas the emission factors developed from the report use one-half of the detection limit as the emission from a “nondetect” run. Detection limits were not provided for ketones, methane, benzene, toluene, ethylbenzene, and xylene. For these pollutants, assumed detection limits were calculated using 80 percent of the smallest detected amount of each pollutant.

A rating of A was assigned to most of the test data, with the following exceptions: methyl ethyl ketone, methane, benzene, ethylbenzene, toluene, and xylene emission data were rated B because detection limits were not provided and at least one “nondetect” run was reported for each pollutant. The report included adequate detail, the methodology was sound, and no problems were reported during the valid test runs.

4.2.1.26 Reference 26. The plant tested was a drum-mix facility with the dryer fired by No. 2 fuel oil and emissions controlled by a fabric filter. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of A was assigned to the test data from the drum mixer. The report included adequate detail, the methodology appeared to be sound, and no problems were reported.

4.2.1.27 Reference 27. The plant tested was a drum-mix facility with the dryer fired by No. 2 fuel oil and emissions controlled by a fabric filter. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of A was assigned to the test data from the drum mixer. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.28 Reference 28. The plant tested was a drum-mix facility with emissions controlled by a fabric filter. The test report included three test runs measuring filterable PM, condensable inorganic PM, and CO_2 emissions from the drum mixer (drying process) at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, condensable inorganic PM was analyzed using the Method 5 back-half catch, and CO_2 was measured using EPA Method 3.

A rating of B was assigned to the test data from the drum mixer. The report included some detail, but it provided only an average production rate, and the fuel used to fire the dryer was not specified. The methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.29 Reference 29. The plant tested was a drum-mix facility with the dryer fired by No. 2 fuel oil and emissions controlled by a venturi scrubber. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the venturi scrubber outlet. The scrubber controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of B was assigned to the test data from the drum mixer. The report included some detail, but it provided only an average production rate and did not specify the pressure drop across the venturi section of the scrubber. The methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.30 Reference 30. The plant tested was a drum-mix facility with a natural gas-fired dryer and emissions controlled by a fabric filter. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of A was assigned to the test data from the drum mixer. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.31 Reference 31. The plant tested was a drum-mix facility with the dryer fired by No. 5 fuel oil and emissions controlled by a fabric filter. The tests were performed at the inlet and outlet of the fabric filter and measured filterable PM and condensable organic PM (referred to as TOC in the test report). The tests were performed during both conventional and recycle operations. The condensable organic PM tests were not considered to be valid because problems were encountered during analysis (the back-half catch adhered to the glassware). During conventional operation, there were two valid test runs at the fabric-filter inlet (Run 1 was not isokinetic) and three valid runs at the fabric-filter outlet. During recycle operation, there were three valid test runs at the fabric-filter inlet and two valid runs at the fabric-filter outlet (only two runs were performed). All of the tests measured emissions from the drum mixer.

A rating of A was assigned to the test data from the tests that included three valid runs, and a rating of B was assigned to the test data from the tests that included only two valid runs. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.32 Reference 32. The plant tested was a drum-mix facility with the dryer fired by No. 2 fuel oil and emissions controlled by a scrubber. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the scrubber outlet. The scrubber controls PM emissions, but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of B was assigned to the test data from the drum mixer. The report included some detail, but it did not provide details about the control system, including the pressure drop across the scrubber. The methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.33 Reference 33. The plant tested was a drum-mix facility with the dryer fired by No. 2 fuel oil and emissions controlled by a fabric filter. The test included three runs measuring filterable PM and CO_2 emissions from the drum mixer (drying process) at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Particulate matter was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3. The test was conducted while the dryer feed included about 33 percent RAP.

A rating of A was assigned to the test data from the drum mixer. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.34 Reference 34. The plant tested was a batch mix facility with the dryer fired by natural gas and emissions controlled by a fabric filter. The test included three runs measuring trace metals, chromium and hexavalent chromium (Cr and Cr^{+6}), PAHs, aldehydes, VOCs, CO, and NO_x emissions from the dryer at the fabric-filter outlet. For target pollutants that were not detected in one or two test runs, emissions from the "nondetect" runs were estimated using one-half of the pollutant detection limit. Several target pollutants were not detected in any run. Trace metals were measured using draft EPA Method 200.7, PAHs were tested using EPA Modified Method 5 (MM5 – now known as Semi-VOST), and CO and NO_x were tested using a CEMS. The other pollutants were measured using California Air Resources Board (CARB) test procedures, which are similar to EPA methods for the pollutants tested.

A rating of B or C was assigned to the data from this test. Data were assigned a C rating if a pollutant was detected in only one of three test runs, or if only two valid test runs were performed. The report included some detail, but it provided only an average production rate. The testing methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.35 Reference 35. The plant tested was a drum-mix facility with the dryer fired by propane and emissions controlled by a fabric filter. The test included three runs measuring trace metals, total chromium and hexavalent chromium (Cr and Cr^{+6}), PAHs, benzene, toluene, xylene, methyl chloroform, formaldehyde, and hydrogen sulfide emissions from the dryer at the fabric-filter outlet. Also included were three test runs measuring PAHs, polychlorinated dibenzofurans (TCDFs, PCDFs, HxCDFs, HpCDFs, and OCDFs), polychlorinated dibenzo(p)dioxins (TCDDs, PeCDDs, HxCDDs, HpCDDs, and OCDDs), benzene, and formaldehyde emissions from the hot oil heater stack. The hot oil heater was fired with No. 2 fuel oil. Trace metals were measured using draft EPA Method 200.7, and PAHs were tested using EPA MM5 (Semi-VOST). The other pollutants were measured using CARB test procedures, which are similar to EPA methods for the pollutants tested. For target pollutants that were not detected in one or two test runs, emissions from the "nondetect" runs were estimated using one-half of the pollutant detection limit. Several target pollutants were not detected in any run. Radionuclide emissions also were sampled during this test, but the information provided is insufficient for emission factor development.

For the drum mix dryer emission testing, a rating of B is assigned to most of the data. A rating of C is assigned if a pollutant was detected in only one of three test runs. The report included some detail, but it provided only an average production rate and did not describe the control system. The test methodology appeared to be sound, and no problems were reported in the valid test runs. The hot oil heater emission test data are assigned a D rating because of the lack of documentation and, more importantly, the large amount of uncertainty associated with the testing and how the testing accounted for the intermittent operation of the system and the resultant changes in exhaust flow and stack gas conditions.

4.2.1.36 Reference 36. The plant tested was a drum-mix facility with a natural gas-fired dryer and emissions controlled by a venturi scrubber (Δp = 15 to 21 in. H_2O). The tests were performed at the inlet and outlet of the scrubber and measured filterable PM and condensable organic PM (referred to as TOC or back-half catch in the report). During conventional and recycle operation, three valid test runs were performed at both the scrubber inlet and outlet. All of the tests measured emissions from the drum mixer.

All of the test data were assigned an A rating. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.37 Reference 37. The plant tested was a drum-mix facility with a natural gas-fired dryer and emissions controlled by a venturi scrubber (Δp = 12.5 to 14.5 in. H_2O). The tests were performed at the inlet and outlet of the scrubber and measured filterable PM and condensable organic PM (referred to as TOC or back-half catch in the report). During conventional and recycle operation, three valid test runs were performed at both the scrubber inlet and outlet. All of the tests measured emissions from the drum mixer.

All of the test data were assigned an A rating. The report included adequate detail, the methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.38 Reference 38. This document is a study of inhalable PM emissions from drum-mix asphalt plants and includes emission data for uncontrolled and controlled filterable PM and size-specific PM emissions from a drum mixer. The particle size data were analyzed during the 1986 revision of AP-42 Section 11.1 and are not discussed here. Filterable PM emissions were measured at both the inlet and outlet of the fabric filter that controls emissions from the drum mixer. The inlet test was conducted using a modified EPA Method 5 train (only six sampling points) for eight runs, and the outlet test was conducted using a modified EPA Method 17 train (only four sampling points) for two runs.

The inlet test data were assigned a B rating, and the outlet test data were assigned a C rating. Both tests were downgraded one letter because of the number of sampling points used, and the outlet test was downgraded another letter because only two test runs were performed. The report included adequate detail, and no problems were reported in the valid test runs.

4.2.1.39 Reference 39. This document contains summary data from seven emission tests conducted at both drum-mix and batch mix HMA plants. All of the tests were conducted at the outlets of fabric filters controlling emissions from the drum mixers/dryers (drum-mix plants) or dryers (batch mix plants) fired by natural gas, No. 2 fuel oil, or No. 6 fuel oil. Pollutants measured at each plant included CO, CO_2, SO_2, NO_X, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAHs, formaldehyde, and condensable PM. Carbon monoxide, CO_2, SO_2, NO_X, and TOC emissions were quantified using CEMS (EPA Methods 10, 3A, 6C, 7E, and 25A, respectively). The Method 25A results were converted to TOC as methane using the measured emission concentration, the density of methane at STP, and the volumetric flow rate for each test run. Methane, benzene, toluene, ethylbenzene, and xylene emissions were measured using EPA Method 18, PAH emissions were measured using EPA MM5, formaldehyde emissions were measured using EPA Method 0011 (proposed method at the time of testing), and condensable PM emissions were measured using EPA Method 202. Condensable PM and PAHs are the only target pollutants that would be expected to be controlled by the fabric filters.

The original test reports are described in Sections 4.2.1.42 through 4.2.1.48 (References 44 through 50) of this document. The individual reports were reviewed, and the data ratings are presented in the individual report descriptions.

4.2.1.40 Reference 40. This reference includes summary data from 25 emission tests performed in Wisconsin. Particulate matter and formaldehyde emissions were quantified using EPA Method 5 and NIOSH Method 3500, respectively. Both drum-mix and batch mix plants using various control systems and fuels were tested.

The filterable PM and total PM data were assigned a C rating because only summary test data were provided. The formaldehyde data were assigned a D rating because the test method suffers from a number of potential interferences, as documented in a letter from Gary McAlister of EPA's Emission Measurement Branch (EMB) (attached to Ref. 40).

4.2.1.41 Reference 41. The plant tested was a batch mix facility with emissions controlled by a fabric filter. The test included three runs measuring filterable PM and CO_2 emissions from the dryer at the fabric-filter outlet. The fabric filter controls PM emissions but provides only incidental, if any, control of CO_2 emissions. Filterable PM was sampled using EPA Method 5, and CO_2 was measured using EPA Method 3.

A rating of B was assigned to the test data from the dryer. The report included some detail, but it provided only an average production rate and did not specify the fuel used to fire the dryer. The test methodology appeared to be sound, and no problems were reported in the valid test runs.

4.2.1.42 Reference 44. This reference documents an emission test conducted on a counter-flow, natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 30 percent RAP during testing. Filterable PM, condensable PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. During each test, three test runs were performed using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report.

Most of the test data are assigned an A rating. The CO data are assigned a D rating because the measured concentrations were above the calibration range in two of the three test runs. The ethyl benzene data are assigned a B rating because the concentration during Run 3 was below an undefined detection limit. The non-detect test run was not included in the calculated average emission factor for ethyl benzene. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.43 Reference 45. This reference documents an emission test conducted on a counter-flow, natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 13 percent RAP during testing. Filterable PM, condensable PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Toluene, ethylbenzene, and xylene emissions were not detected during any test run, and anthracene was detected in only one of three test runs. Emissions of toluene, ethylbenzene, and xylene were estimated as one-half of the detection limit, which was estimated as 0.1 ppm. This detection limit was used because several recorded benzene measurements (same test method) were below 1 ppm (1 ppm is the recorded detection limit for a similar test documented in Reference 48). During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report.

Most of the test data are assigned an A rating. The CO data are not rated because the measured concentrations were above the calibration range during all of the test runs. The benzene and pyrene data are assigned a B rating because the concentration during one run (for each pollutant) was below an undefined detection limit. The toluene, ethylbenzene, and xylene data are assigned a C rating because the emissions are estimates. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.44 Reference 46. This reference documents an emission test conducted on a counter-flow, natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene were detected in only one of three test runs (emission factors were not developed for these three pollutants). During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report. The continuous emission monitors (CEMS) for CO, SO_2, and NO_x were used during nine test runs on three different days. The TOC monitor was only used on the first day of testing (three runs).

Most of the test data are assigned an A rating. The methane data are assigned a B rating because the concentration during one run was below an undefined detection limit. This non-detect test run is not included in the calculated average emission factor for methane. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.45 Reference 47. This reference documents an emission test conducted on a counter-flow, natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Benzene, toluene, ethylbenzene, and xylene emissions were not detected during any test run, and acenaphthene was detected in only one of three test runs. Emissions of benzene, toluene, ethylbenzene, and xylene were estimated as one-half of the detection limit, which was estimated as 1 ppm (1 ppm is the recorded detection limit for a similar test documented in Reference 48). During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report. The continuous emission monitors (CEMS) for CO, CO_2, SO_2, NO_x, and TOC were used during nine test runs on three different days. The isokinetics during Run 3 for condensable PM were not within the specified limits; therefore, this run is not considered valid.

Most of the test data are assigned an A rating. The filterable and condensable PM data are assigned a B rating because only two valid test runs were performed. The benzene, toluene, ethylbenzene, and xylene data are assigned a C rating because the emissions are estimates. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.46 Reference 48. This reference documents an emission test conducted on a parallel-flow, natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Methane, benzene, toluene, ethylbenzene, xylene, and 2-chloronaphthalene emissions were not detected during any test run, and dibenz(a,h)anthracene was detected in only one of three test runs. Emissions of methane, benzene, toluene, ethylbenzene, and xylene were estimated as one-half of the detection limit, which was estimated as 1 ppm (1 ppm is the recorded detection limit for a similar test documented in Reference 48). The formaldehyde data are not presented in the report because of problems encountered during sample analysis. During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report. The continuous emission monitors (CEMS) for CO_2, NO_x, and TOC were used during six test runs on five different days. The continuous emission monitors (CEMS) for CO and SO_2 were used during five test runs on four different days.

Most of the test data from this report are assigned an A rating. The methane, benzene, toluene, ethylbenzene, and xylene data are assigned a C rating because the emissions are estimates. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.47 Reference 49. This reference documents an emission test conducted on a counter-flow, No. 6 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was processing about

30 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Benzene, toluene, ethylbenzene, and xylene emissions were not detected during any test run. Emissions of benzene, toluene, ethylbenzene, and xylene were estimated as one-half of the detection limit, which was estimated as 1 ppm (1 ppm is the recorded detection limit for a similar test documented in Reference 48). During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report. The continuous emission monitors (CEMS) for CO, CO_2, SO_2, NO_x, and TOC were used during nine test runs conducted on three different days.

Most of the test data are assigned an A rating. The phenanthrene data are assigned a B rating because the concentration during one run was below an undefined detection limit. This non-detect test run is not included in the calculated average emission factor for phenanthrene. In addition, the formaldehyde data are assigned a B rating because the data range over two orders of magnitude. The benzene, toluene, ethylbenzene, and xylene data are assigned a C rating because the emissions are estimates. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.48 Reference 50. This reference documents an emission test conducted on a counter-flow, No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 35 percent RAP during testing. Filterable PM, condensable PM, CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, xylene, PAH, and formaldehyde emissions were measured at the fabric-filter outlet. Toluene and xylene emissions were not detected during any test run, benzene and ethylbenzene emissions were detected in only one of nine test runs, and fluoranthene emissions were detected in only one of three test runs. During each test, three test runs were performed (except as noted) using the EPA reference test methods discussed in the review of Reference 39 (Section 4.2.1.39) in this report. The continuous emission monitors (CEMS) for CO, CO_2, SO_2, NO_x, TOC, methane, benzene, toluene, ethylbenzene, and xylene were used during nine test runs conducted on three different days. The SO_2 results are not presented in the report because the SO_2 monitor malfunctioned during testing.

Concentrations of benzene, toluene, ethylbenzene, and xylene were estimated as one-half of the detection limit, which was estimated as 80 percent of the lowest (only) recorded ethylbenzene measurement (0.80 x 0.36 ppm = 0.29 ppm). These concentrations were used to estimate emissions for all of the test runs except for the single benzene and ethylbenzene runs that had measurable concentrations.

Most of the test data are assigned an A rating. The CO data are not rated because the measured concentrations were above the calibration range during all of the test runs. The pyrene data are assigned a B rating because the concentration during one run was below an undefined detection limit. This non-detect test run is not included in the calculated average emission factor for pyrene. The benzene, toluene, ethylbenzene, and xylene data are assigned a C rating because the emissions are estimates. The report included adequate detail, the methodology was sound, and no problems were reported.

4.2.1.49 Reference 51. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 28 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.50 Reference 52. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Four test runs were conducted for each pollutant, but Run 1 was not valid due to process problems. Process rates were provided for each test run. The venturi scrubber pressure drop was 13 in. w.c.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported during the three valid test runs.

4.2.1.51 Reference 53. This reference documents an emission test conducted on a fuel oil-fired (Nos. 1, 2, and 3 fuel oil), drum-mix dryer controlled by a fabric filter. The facility was processing about 31 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.52 Reference 54. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 44 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.53 Reference 55. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 32 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.54 Reference 56. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 30 percent RAP during testing. Filterable PM-10, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 201A, Method 5 (back-half analysis), and Method 3 (with an Orsat analyzer for CO_2 analysis). All of the Method 201A test runs were above 120 percent isokinetics. Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data for PM-10 are assigned a C rating because the Method 201A isokinetic requirements were not met during any of the test runs. The condensable organic PM and CO_2 data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.55 Reference 57. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The venturi scrubber pressure drop averaged 15 in. w.c. during testing. The plant was out of compliance with State regulations for PM emissions. This plant is the same plant tested in References 58, 59, and 60.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.56 Reference 58. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, Run 2 is not considered valid because a sample line connection opened during the test. The venturi scrubber pressure drop averaged 8.9 in. w.c. during testing. The plant was out of compliance with State regulations for PM emissions. This plant is the same plant tested in References 57, 59, and 60.

The test data are assigned a B rating. The report includes adequate detail and the test methodology was sound, but only two valid test runs were conducted.

4.2.1.57 Reference 59. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The venturi scrubber pressure drop averaged 9.3 in. w.c. during testing. The plant was out of compliance with State regulations for PM emissions. This plant is the same plant tested in References 57, 58, and 60.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.58 Reference 60. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The venturi scrubber pressure drop averaged 12 in. w.c. during testing. The plant was out of compliance with State regulations for PM emissions. This plant is the same plant tested in References 57, 58, and 59.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.59 Reference 61. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a wet scrubber. The facility was processing about 35 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged 10 in. w.c. during testing. The plant was out of compliance with State regulations for PM emissions. This plant is the same plant tested in Reference 62.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.60 Reference 62. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a wet scrubber. The facility was processing about 26 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged 10 in. w.c. during testing. Although filterable PM loadings were relatively high (0.08 grains/dry standard cubic foot [G/dscf]), the facility was in compliance because the plant has been operating since 1957 and must meet a grain loading of 0.4 G/dscf rather than the NSPS maximum grain loading of 0.04 grains/dscf. This plant is the same plant tested in Reference 61.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.61 Reference 63. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 52 percent RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.62 Reference 64. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 40 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.63 Reference 65. This reference documents an emission test conducted on a butane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 30 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and

Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.64 Reference 66. This reference documents an emission test conducted on a waste oil-fired, continuous mix dryer controlled by a multiclone and fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.65 Reference 67. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a wet scrubber. The testing was performed to compare emissions from processing only virgin aggregate to emissions from processing virgin aggregate and RAP. Two test runs were conducted while processing only virgin aggregate, and three test runs were conducted while processing about 46 percent RAP. Process rates were provided for each test run. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet during both tests. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). The scrubber pressure drop averaged 10 in. w.c. during testing. The results showed that filterable PM emissions were about 50 percent less during RAP processing, while condensable organic PM emissions were about 300 percent greater during RAP processing. As expected, CO_2 emissions were not affected by RAP processing.

The test data for virgin aggregate processing are assigned a B rating because only two test runs were conducted. The test data for RAP processing are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.66 Reference 68. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 48 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.67 Reference 69. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The venturi scrubber pressure drop averaged 17 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.68 Reference 70. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The venturi scrubber pressure drop averaged 12.5 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.69 Reference 71. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.70 Reference 72. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.71 Reference 73. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 31 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.72 Reference 74. This reference documents two emission tests conducted on waste oil-fired, drum-mix dryers controlled by fabric filters. The first facility was processing about 18 percent RAP during testing, and the second facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlets. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant at both plants, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.73 Reference 75. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a wet scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, the Run 2 filterable PM data are not considered valid because the Method 5 isokinetic requirements were not met. The scrubber pressure drop averaged 9.3 in. w.c. during testing.

The filterable PM data are assigned a B rating because only two valid test runs were conducted. The condensable organic PM and CO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.74 Reference 76. This reference documents an emission test conducted on a natural gas-fired, counter-flow, batch-mix dryer controlled by dual wet scrubbers in series. The facility was processing about 30 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured following the second scrubber. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The total scrubber pressure drop averaged 3.1 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.75 Reference 77. This reference documents an emission test conducted on a waste oil-fired, counter-flow, batch-mix dryer controlled by a wet scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged 4.0 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.76 Reference 78. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. This plant is the same plant tested in References 57-60, but the venturi scrubber that was in place during the earlier tests was replaced with a fabric filter prior to this test.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.77 Reference 79. This reference documents an emission test conducted on a waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility was processing about 26 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.78 Reference 80. This reference documents an emission test conducted on a waste oil-fired, batch-mix dryer controlled by a wet scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Four test runs were conducted for each pollutant, but Run 1 was not completed due to moisture in the pitot tube lines. Process rates were provided for each test run. The scrubber pressure drop averaged 3.3 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.1.79 Reference 81. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 50 percent RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.80 Reference 82. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 42 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.81 Reference 83. This reference documents an emission test conducted on a waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility was processing about 15 percent RAP during testing. Filterable PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.82 Reference 84. This reference documents an emission test conducted on a natural gas-fired, parallel-flow, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.83 Reference 85. This reference documents an emission test conducted on a No. 2 fuel oil-fired, parallel-flow, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was not recorded during testing. During testing, the plant had problems with the automatic damper, so the damper was manually opened. The problems with the damper caused air flow problems that may have affected emissions.

The test data are assigned a C rating because of the problems with the automatic damper and the omission of the scrubber pressure drop.

4.2.1.84 Reference 86. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM, condensable organic PM, condensable inorganic PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.85 Reference 87. This reference documents an emission test conducted on a natural gas and coal-fired, parallel-flow, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged between 20 and 22 in. w.c. during testing.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM, condensable organic PM, condensable inorganic PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.86 Reference 88. This reference documents an emission test conducted on a natural gas and coal-fired, parallel-flow, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis), Method 3 (with a Fyrite analyzer for CO_2 analysis), and a modified Method 6 (analysis of Method 5 back-half catch with a barium perchlorate and thorin titration). Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, the Run 3 filter was contaminated, invalidating the filterable PM data from Run 3. The scrubber pressure drop averaged 16 in. w.c. during testing.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned a B rating because only two valid test runs were completed. The SO_2 test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.87 Reference 89. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The amount of RAP processed was not discussed in the report. Therefore, it is assumed that the facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a C rating because the use of RAP is not addressed in the report and only an average process rate is provided. Otherwise, the test methodology was sound, and no problems were reported.

4.2.1.88 Reference 90. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The amount of RAP processed was not discussed in the report. Therefore, it is assumed that the facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a C rating because the use of RAP is not addressed in the report and only an average process rate is provided. Otherwise, the test methodology was sound, and no problems were reported.

4.2.1.89 Reference 91. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.90 Reference 92. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test. Run 1 failed to meet the Method 5 isokinetic requirements, and the Run 1 filterable PM data are not considered valid.

The test data are assigned a B rating because only an average process rate was provided and only two valid Method 5 runs were conducted. Otherwise, the report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.91 Reference 93. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.92 Reference 94. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.93 Reference 95. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an unspecified analyzer for CO_2 analysis). Four test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because an unspecified analyzer (Fyrite or Orsat) was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.94 Reference 96. This reference documents an emission test conducted on a drum-mix dryer controlled by a venturi scrubber. The fuel used to fire the dryer is not specified, and the use of RAP is not addressed in the report. Filterable PM, condensable PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and an unspecified method for CO_2. Three test runs were conducted for each pollutant, and process rates were provided for each test run. Run 3 failed to meet the Method 5 isokinetic requirements, and the Run 3 data are not considered valid.

The test data are assigned a D rating because the dryer fuel is not specified, the use of RAP is not addressed, and the scrubber pressure drop is not included in the report.

4.2.1.95 Reference 97. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.96 Reference 98. This reference documents an emission test conducted on a propane- (25 percent) and coal- (75 percent) fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, SO_2, and combined sulfur trioxide (SO_3) and sulfuric acid (H_2SO_4) emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis), Method 3 (with a Fyrite analyzer for CO_2 analysis), and EPA Method 8 for the determination of SO_2 and H_2SO_4 emissions. Three test runs were conducted for each pollutant, and process rates were provided for each test run. The SO_2 and H_2SO_4 data are not considered valid because high gas stream moisture contents caused a low bias in the SO_2 measurements and a high bias in the H_2SO_4 measurements.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported except for the biases in the SO_2 and H_2SO_4 data.

4.2.1.97 Reference 99. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was 13 to 14 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.98 Reference 100. This reference documents an emission test conducted on a batch mix (assumed) dryer controlled by a fabric filter. The fuel used to fire the dryer was not specified, and the facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). In addition, a Method 5 back-half acetone rinse was performed per Pennsylvania protocol. The data from this acetone rinse are not used for emission factor development because they are not comparable to condensable PM data obtained using EPA methodology. Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, Run 3 was cut short due to process shutdown and is not considered valid.

The test data are assigned a C rating because adequate details about the process are not included in the report and only two valid test runs were conducted.

4.2.1.99 Reference 101. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable organic PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.100 Reference 102. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The filterable PM measurements are not valid because all three test runs failed the Method 5 isokinetic requirements.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are not rated because of the problems discussed above.

4.2.1.101 Reference 103. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 15 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.102 Reference 104. This reference documents an emission test conducted on a fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a B rating because only an average process rate was provided for the test. Otherwise, the report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.103 Reference 105. This reference documents an emission test conducted on a No. 2 fuel oil-fired, parallel-flow, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a B rating because only an average process rate was provided for the test. Otherwise, the report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.104 Reference 106. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.105 Reference 107. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 26 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.106 Reference 108. This reference documents an emission test conducted on a fuel oil- and coal-fired, parallel-flow, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front-half analysis), Method 3 (with a Fyrite analyzer for CO_2 analysis), and a modified Method 6 (analysis of Method 5 back-half catch with a barium perchlorate and thorin titration). Two valid test runs were conducted for each pollutant, and process rates were provided for each test run. During the third test run, the filter was contaminated, invalidating the filterable PM data from Run 3. An SO_2 analysis was not conducted for Run 3. The scrubber pressure drop averaged 17 in. w.c. during testing.

The test data are assigned a B rating because only two valid test runs were completed. The report includes adequate detail and the test methodology was sound.

4.2.1.107 Reference 109. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 and Method 3 (with an unspecified analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was not provided in the report.

The CO_2 test data are assigned a B rating because the type of analyzer was not specified. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.108 Reference 110. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.109 Reference 111. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.110 Reference 112. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.111 Reference 113. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Six test runs were conducted for each pollutant, and process rates were provided for each test run. However, three of the test runs failed post-test leak checks, and the data from these test runs are not valid.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.112 Reference 114. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.113 Reference 117 . This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 12 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.114 Reference 118. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing.

Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.115 Reference 119. This reference documents an emission test conducted on a fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, CO_2, and SO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and unspecified methods for CO_2 and SO_2 (apparently EPA Method 3 and a modified Method 5 (back-half) with a barium perchlorate and thorin titration). Three valid test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged 17 in. w.c. during testing. The fuel oil contained 0.35 percent sulfur.

The CO_2 and SO_2 test data are assigned a C rating because adequate detail about the test methods are not included in the report. The PM data are assigned an A rating. The report includes adequate detail and the test methodology appears to be sound.

4.2.1.116 Reference 121. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.117 Reference 122. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 16 percent RAP during testing. Filterable PM emissions were measured at the fabric-filter outlet using EPA Method 5 (front-half analysis). Three test runs were conducted, and process rates were provided for each test run. Two tons per hour of hydrated lime were added to the mix during each test run. This addition did not appear to affect emissions of the measured pollutants.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.118 Reference 123. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.119 Reference 124. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 22 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.120 Reference 125. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.121 Reference 126. This reference documents an emission test conducted on a propane- (30 percent) and coal- (70 percent) fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis), Method 3 (with a Fyrite analyzer for CO_2 analysis), and a modified EPA Method 8 for the determination of SO_2 and SO_3 emissions. Insufficient information about the SO_3 test is provided in the report. Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM and SO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.122 Reference 128. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.123 Reference 130. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing.

Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, only two of the test runs were completed because of a plant shutdown.

The test data are assigned a B rating because only two valid test runs were completed. The report includes adequate detail, the test methodology was sound, and no other problems were reported.

4.2.1.124 Reference 132. This reference documents an emission test conducted on a coal- (95 percent) and natural gas- (5 percent) fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.125 Reference 133. This reference documents an emission test conducted on a coal- (90 percent) and natural gas- (10 percent) fired, drum-mix dryer controlled by a fabric filter. During Run 1, the facility used only natural gas, but the emissions did not differ significantly from Runs 2 and 3. The facility did not process RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. A small leak was detected during the Run 2 post-test leak check, and the gas volume was corrected per the Code of Federal Regulations (CFR).

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.126 Reference 135. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a B rating because only an average process rate was provided for the test. Otherwise, the report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.127 Reference 137. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The test included two test runs while processing virgin aggregate and two runs while processing about 31 percent RAP. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Four test runs were conducted for each pollutant, and process rates were provided for each test run. Two additional test runs (one for virgin aggregate and one for RAP) were planned, but and electrical storm and plant electrical problems caused the runs to be canceled. The data for virgin aggregate and RAP processing are presented separately in the summary tables of this background report.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.128 Reference 138. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.129 Reference 139. This reference documents an emission test conducted on a batch-mix dryer (unspecified fuel) controlled by a scrubber. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was not documented in the report.

The test data are assigned a C rating because the report did not contain sufficient detail about the process. Otherwise, the test methodology was sound and no problems were reported.

4.2.1.130 Reference 140. This reference documents an emission test conducted on a waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and an average process rate was provided for the test.

The test data are assigned a B rating because only an average process rate was provided. Otherwise, the report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.131 Reference 141. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing about 29 percent RAP during testing. Filterable PM, CO_2, and formaldehyde emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5, Method 3 (with an unspecified analyzer for CO_2 analysis), and NIOSH Method 3500, respectively. Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was not provided in the report.

The CO_2 test data are assigned a B rating because the type of analyzer was not specified. The formaldehyde data are assigned a D rating because of the test method is not believed to accurately quantify emissions from this type of source. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound (except as noted), and no problems were reported.

4.2.1.132 Reference 142. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing about 35 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with an Orsat analyzer for CO_2 analysis). Emissions of several metals were quantified by atomic absorption analysis of the Method 5 filter catch. Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was between 13 and 14 in. w.c. during testing.

The PM and CO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound (except as noted), and no problems were reported. The metals data are assigned a D rating because the test method appeared to differ significantly from the EPA Reference method.

4.2.1.133 Reference 143. This reference documents an emission test conducted on a waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, CO_2, and formaldehyde emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis), Method 3 (with an Orsat analyzer for CO_2 analysis), and NIOSH Method 3500, respectively. Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The formaldehyde data are assigned a D rating because of the test method is not believed to accurately quantify emissions from this type of source. The PM and CO_2 data are assigned an A rating. The report includes adequate detail, the test methodology was sound (except as noted), and no problems were reported.

4.2.1.134 Reference 144. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 38 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. However, only two of the test runs were valid because of atypical process operations during Run 1.

The test data are assigned a B rating because only two valid test runs were completed. The report includes adequate detail, the test methodology was sound, and no other problems were reported.

4.2.1.135 Reference 145. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop was greater than 15 in. w.c. during testing. The filterable PM emissions from this facility are higher than most of the other similar facilities tested.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.136 Reference 146. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing about 31 percent RAP during testing. Filterable PM, CO_2, and formaldehyde emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5, Method 3 (with an Orsat analyzer for CO_2 analysis), and NIOSH Method 3500, respectively. Three test runs were conducted for each pollutant, and process rates were provided for each test run. The scrubber pressure drop averaged 19 in. w.c. during testing.

The formaldehyde data are assigned a D rating because of the test method is not believed to accurately quantify emissions from this type of source. The PM and CO_2 data are assigned an A rating. The report includes adequate detail, the test methodology was sound (except as noted), and no problems were reported.

4.2.1.137 Reference 147. This reference documents an emission test conducted on a waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis) and Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.138 Reference 148. This reference documents an emission test conducted on a No. 5 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing about 50 percent RAP during testing. Filterable PM and condensable inorganic PM emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5 (front- and back-half analysis). Three test runs were conducted, and process rates were provided for each test run. The scrubber pressure drop averaged 17 in. w.c. during testing.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.139 Reference 149. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, CO, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis), EPA Method 10, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with a Fyrite analyzer for CO_2 analysis). Four test runs were conducted for each pollutant, but Run 3 is not considered valid because it failed a post-test leak check. Process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM, CO, and TOC test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.140 Reference 153. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, NO_x, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis), EPA Method 7D, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with an Orsat analyzer for CO_2

analysis). Three test runs were conducted for each pollutant (five CO_2 runs), and process rates were provided for each test run.

The test data are assigned a B rating because the report lacks sufficient background documentation. Otherwise, the test methodology was sound, and no problems were reported.

4.2.1.141 Reference 154. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, CO, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5 (front-half analysis), EPA Method 10, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for PM and CO_2, and one test run was conducted for CO and TOC. Process rates were provided for each test run.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The CO and TOC data are assigned a C rating because only one test run was performed. The PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.142 Reference 155. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Carbon monoxide, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 10, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with an unspecified analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run.

The CO_2 test data are assigned a B rating because the analyzer was not specified. The CO and TOC test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.143 Reference 160. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, CO, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5, EPA Method 10, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. Carbon monoxide was only detected in one of three test runs, and TOC were not detected during any test run. The CO and TOC data conflict with all of the other data available for similar sources and are not considered valid.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.144 Reference 161. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility did not process RAP during testing. Filterable PM, CO, TOC (as propane), and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5, EPA Method 10, New Jersey Method 3 (equivalent to EPA Method 25A), and EPA Method 3 (with a Fyrite analyzer for CO_2 analysis). Three test runs were conducted for each pollutant, and process rates were provided for each test run. The TOC data indicate that emissions from this source are more than an order of magnitude greater than TOC emissions from similar sources.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The TOC test data are assigned a C rating because the magnitude of emissions is not consistent with emissions from similar sources. The filterable PM and CO test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.145 Reference 162. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a wet scrubber. The facility was not processing RAP during testing. Multiple metals, lead, chromium (and hexavalent chromium (Cr^{+6}), CO2, PAH, benzene, and formaldehyde emissions were measured at the scrubber outlet. These pollutants were measured using EPA Method 29 (draft method at the time of the test), CARB Method 12, CARB Method 425, CARB Method 429, CARB Method 3 (with an unspecified analyzer), CARB Method 410A, and CARB Method 430, respectively. Two test runs were conducted for each pollutant (eight CO_2 measurements), and production rates were provided for each test run. The multiple metals test detected mercury, zinc, and manganese during both runs, and detected cadmium, copper, and lead during one run. Arsenic, beryllium, nickel, and selenium were not detected. The lead test detected lead during both test runs, and the chromium test detected chromium (however, Cr^{+6} was not detected) during both test runs. The PAH test indicated that naphthalene was the primary PAH emitted from the source. Phenanthrene was also detected by both test runs, and anthracene was detected during one run. Insufficient information on the benzene and formaldehyde tests was provided in the report.

Most of the test data are assigned a B rating. Data for compounds that were not detected during one test run are assigned a C rating, and data for pollutants that were not detected during any test run are not rated. Except as noted, the report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.146 Reference 163. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Multiple metals, chromium (and Cr^{+6}), CO2, PAH, and benzene emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 29 (draft method at the time of the test), CARB Method 425, CARB Method 429, CARB Method 3 (with an unspecified analyzer), and CARB Method 410A, respectively. Three test runs were conducted for each pollutant (two chromium tests and eight CO_2 measurements), and production rates were provided for each test run. The multiple metals test detected copper, mercury, nickel, zinc, and manganese during all three runs. Arsenic, beryllium, cadmium, lead, and selenium were not detected during any test run. The chromium test detected chromium during both test runs and Cr^{+6} during one test run. Hexavalent chromium emissions were estimated for the non-detect run as one-half of the detection limit. Hexavalent chromium accounted for about 18 percent of the total chromium emissions during the two tests. The PAH test indicated that naphthalene was the primary PAH emitted from the source. Fluorene and phenanthrene also were detected by all three test runs, and pyrene was detected during one run. Insufficient information on the benzene test was provided in the report.

Most of the test data are assigned an A rating. The chromium data are assigned a B rating because only two test runs were conducted, and the Cr^{+6} data are assigned a C rating because one of two runs did not detect Cr^{+6}. Except as noted, the report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.147 Reference 164. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Multiple metals, chromium (and Cr^{+6}), arsenic, CO2, PAH, benzene and formaldehyde emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 29 (draft method at the time of the test), CARB Method 425, CARB Method 423, CARB Method 429, CARB

Method 3 (with an unspecified analyzer), CARB Method 410A, and CARB Method 430, respectively. Three test runs were conducted for each pollutant (nine CO_2 measurements), and production rates were provided for each test run. The multiple metals test detected copper, mercury, nickel, lead, zinc, and manganese during all three runs. Arsenic, beryllium, cadmium, and selenium were not detected during any test run. The chromium test detected chromium during all three test runs, but did not detect Cr^{+6} during any test run. The arsenic test did not detect arsenic during any test run; this finding agrees with the multiple metals test results. The PAH test indicated that naphthalene was the primary PAH emitted from the source. Fluorene and phenanthrene also were detected by all three test runs, and no other PAH were detected. Insufficient information on the benzene and formaldehyde tests was provided in the report.

The test data are assigned an A rating. Except as noted, the report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.148 Reference 165. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analysis) and 3A, respectively. Two test runs were conducted for each pollutant. This facility is the same facility described in Reference 170. However, during the test described in Reference 170, No. 2 fuel oil was used to fire the dryer.

The test data are assigned a B rating because only two test runs were conducted. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.149 Reference 166. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 17.2 in. w.c. The report stated that the demister/particle separator may not have been operating properly. This may have caused collected PM to become reentrained in the gas stream.

The filterable PM data are assigned a D rating because of the possible problem with the control system. The CO_2 test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.150 Reference 167. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. Run 1 of the filterable PM test was not valid because the isokinetic variation was greater than 110 percent.

The filterable PM test data are assigned a B rating because only two valid test runs were conducted. The CO_2 data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.1.151 Reference 168. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 27 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Four test runs were conducted, but the PM data from three of the runs are not valid because the isokinetic variation exceeded the Method 5 requirements. Three of the test runs included CO_2 measurements.

The filterable PM test data are assigned a C rating because only one valid test run was performed. The CO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.1.152 Reference 170. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analysis) and 3A, respectively. Three test runs were conducted for each pollutant. This facility is the same facility described in Reference 165. However, during the test described in Reference 165, propane was used to fire the dryer.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.153 Reference 171. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. A Method 5 back-half analysis was performed, but the analysis was not described; therefore, only filterable PM measurements were used. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.154 Reference 172. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The pressure drop across the venturi scrubber was 15.7 in. w.c..

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.155 Reference 173. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analysis) and 3A, respectively. Three test runs were conducted for each pollutant. Test Run 1 was not valid because the isokinetic variation was less than the required 90 percent.

The test data are assigned a C rating. Run 1 was not valid because a leak was detected during the post-test leak check. Also, only an average production rate was given. The test methodology was sound and no problems were reported during the valid test runs.

4.2.1.156 Reference 174. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.157 Reference 175. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A (with a Fyrite analyzer for CO_2 analysis), respectively. Two test runs were conducted for each pollutant.

The test data are assigned a B rating because only two test runs were conducted. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.158 Reference 176. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 201/202 and 3A, respectively. Four test runs were conducted for each pollutant. Run 1 had an isokinetic variation greater than 110 percent and was replaced with test run 4.

The test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.159 Reference 177. This reference documents an emission test conducted on a No. 4 waste oil-fired, batch-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2 and lead emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5, 3A, and 12, respectively. Three test runs were conducted for each pollutant. The moisture could not accurately be measured during Run 1. The isokinetic variation was below the required 90 percent during Run 2. During Runs 2 and 3, aggregate was dried, but asphalt was not produced because production was canceled for the day. Because the plant is a batch mix plant, the emissions from Run 3 should be representative of typical operations. The scrubber pressure drop is not provided in the report.

The test data are assigned a C rating because of the problems discussed above.

4.2.1.160 Reference 178. This reference documents an emission test conducted on a No. 4 waste oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, and lead emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3A, and 12, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.161 Reference 179. This reference documents an emission test conducted on a No. 4 waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and lead emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5, 3A (with a Fyrite analyzer for CO_2 analysis), and 12, respectively. Three test runs were conducted for each pollutant. The moisture content could not be determined on run

2; therefore, the average of test runs 1 and 3 was used. The venturi scrubber pressure drop was reported as .21 in. w.c. which was interpreted as 21 in. w.c.. The facility tested is the same facility described in Reference 183.

The test data are assigned a B rating due to the problem measuring the moisture content in run 2. The report includes adequate detail and the test methodology was sound.

4.2.1.162 Reference 180. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The test report mentioned fabric filter and scrubber for the control device used. After examining the data sheets, it appears that the control being used is a fabric filter The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.163 Reference 181. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.164 Reference 182. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. An average production rate was provided for the test.

The test data are assigned a B rating because only an average process rate was reported. The test methodology was sound, and no problems were reported.

4.2.1.165 Reference 183. This reference documents an emission test conducted on a No. 4 waste oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and lead emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5, 3A, and 12, respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 179.

The test data are assigned a B rating because the venturi scrubber pressure drop was not provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.166 Reference 184. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.167 Reference 186. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.168 Reference 187. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a wet scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the wet scrubber outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was greater than 9 in w.c..

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.169 Reference 188. This reference documents an emission test conducted on a natural gas or No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned a B rating. The report includes adequate detail except for type of fuel being used, the test methodology was sound, and no problems were reported.

4.2.1.170 Reference 189. This reference documents an emission test conducted on a coal and natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3A (with a Fyrite analyzer for CO_2 analysis) and 8, respectively. Three test runs were conducted for each pollutant. The first test run was found to be out of compliance (for PM).

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The other test data are assigned an A rating. The report includes adequate detail, no problems were reported, and the test methodology was sound.

4.2.1.171 Reference 190. This reference documents an emission test conducted on a No. 2 fuel oil- and coal-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3A, and 8, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.172 Reference 191. This reference documents an emission test conducted on a drum-mix dryer controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was given as 0.11 in w.c.

The test data are assigned a C rating. The fuel used to fire the dryer was not specified. The test methodology was sound. A notice of violation was issued for excess particulate emissions.

4.2.1.173 Reference 192. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.174 Reference 193. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. A total of three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.175 Reference 195. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.176 Reference 196. This reference documents an emission test conducted on No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. However, the Method 5 sampling train was modified per San Diego requirements, which specify that the front-half filter be removed from the sampling train. Therefore, the PM data are not comparable to other available data and are not used for emission factor development. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because only an average process rate was provided in the report. The CO_2 test methodology was sound, and no problems were reported.

4.2.1.177 Reference 197. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, CO_2, and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15, ST-5, and ST-6, which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management District are equivalent to EPA Methods 5, 3A, and 10, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a B rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.178 Reference 198. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 6 percent RAP during test run #1. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 205. However, during the test described in Reference 205, No. 4 fuel oil was used to fire the dryer.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.179 Reference 199. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.180 Reference 200. This reference documents an emission test conducted on a reprocessed oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, only the filterable PM data were used to develop emission factors. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 202.

The test data are assigned a B rating due to minor problems with Test 1. The report includes adequate detail and the test methodology was sound.

4.2.1.181 Reference 201. This reference documents an emission test conducted on a reprocessed oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, only the filterable PM data were used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.182 Reference 202. This reference documents an emission test conducted on a batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 200.

The test data are assigned a C rating. The fuel type was not specified. The test methodology was sound, and no problems were reported.

4.2.1.183 Reference 203. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.184 Reference 204. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, CO_2 and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15, ST-5, and ST-6, which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management District are equivalent to EPA Methods 5, 3A, and 10, respectively. The CO value for Run #2 was a low estimate, but was included in developing emission factors since it was the highest of the three measurements. Three test runs were conducted for each pollutant.

The test data are assigned a B rating. The test report was lacking in detail. The test methodology was sound. Run #2 for CO was a low estimate.

4.2.1.185 Reference 205. This reference documents an emission test conducted on a #4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 14 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 198. However, during the test described in Reference 198, natural gas was used to fire the dryer.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.186 Reference 206. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The report indicated that the facility was processing 100 percent RAP during testing, but this information is assumed to be incorrect because technology is not available to produce HMA using 100 percent RAP. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.187 Reference 209. This reference documents an emission test conducted on a parallel-flow, propane-fired, drum-mix dryer controlled by a fabric filter. The dryer is equipped with a "low-NO_x" burner. Data on RAP processing are not provided in the report. Filterable PM, CO_2, CO, NOx, and hydrocarbons emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 201, 3A, 10, 7e, and 25A respectively. A back-half PM analysis was performed, but the method used was not described and the PM was not labeled as condensable inorganic or condensable organic. Therefore, the condensable PM data are not used for emission factor development. Three test runs were conducted for each pollutant.

The test data are assigned a B rating because only an average process rate was provided in the report. The test methodology was sound and no problems were reported.

4.2.1.188 Reference 210. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM, CO_2, and TOC emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3A, and 25A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. It was noted during sample clean-up that there was a film of oil in the impinger catch. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail and the test methodology was sound.

4.2.1.189 Reference 211. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and TOC emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 (modified to incorporate Pennsylvania Department of Environmental Resources requirements), 3A (with a Fyrite analyzer for CO_2 analysis), and 25A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. The venturi scrubber pressure drop is 20.5 in. w.c.. Three test runs were conducted for each pollutant. The TOC data are provided "as methane" and converted to a propane basis. The facility tested is the same facility described in Reference 212.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The other test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.190 Reference 212. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing 25 percent RAP for Run 4 only. Filterable PM, CO_2, and TOC (as propane) emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 (modified to incorporate

Pennsylvania Department of Environmental Resources (PA DER) requirements), 3A (with a Fyrite analyzer for CO_2 analysis), and 25A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. The venturi scrubber pressure drop was 21 in w.c.. Four test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 211.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The other test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.191 Reference 213. This reference documents an emission test conducted on a natural gas-fired, batch-mix (assumed) dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a B rating because the process type (batch or drum) was not explicitly stated in the report. The test methodology was sound, and no problems were reported.

4.2.1.192 Reference 214. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, SO_2, CO, CO_2, NOx, and TOC emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 6, 10, 3A, 7e, and 25A, respectively. Three test runs were conducted for each pollutant. In addition, a particle size analysis was performed with a cascade impactor (two test runs). The particle size data are used to calculate PM-2.5 and PM-1 emission factors.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.193 Reference 215. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, CO_2, and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15, ST-5, and ST-6, which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management District are equivalent to EPA Methods 5, 3A, and 10, respectively. Three test runs were conducted for each pollutant. All three CO measurements indicated that the CO concentration was above the instrument calibration range. Therefore, CO emissions are estimated as the upper limit of the calibration range, or 2,000 ppm. The process type was obtained from Mr. Chuck McClure by telephone. The facility tested is the same facility described in References 216 and 217.

The CO test data are assigned a C rating because the emissions are estimates based on the upper limit of the calibration range. The other test data are assigned a B rating because the test report does not contain sufficient detail. The test methodology appeared to be sound.

4.2.1.194 Reference 216. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, CO_2, and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15, ST-5, and ST-6, which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management

District are equivalent to EPA Methods 5, 3A, and 10, respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in References 215 and 217.

The test data are assigned a B rating because the test report does not contain sufficient detail. The test methodology appeared to be sound.

4.2.1.195 Reference 217. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, CO_2 and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15, ST-5, and ST-6, which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management District are equivalent to EPA Methods 5, 3A, and 10, respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in References 215 and 216.

The test data are assigned a B rating because the test report does not contain sufficient detail. The test methodology appeared to be sound.

4.2.1.196 Reference 218. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.197 Reference 219. This reference documents an emission test conducted on a coal and liquid propane-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.198 Reference 220. This reference documents an emission test conducted on a counter-flow, propane-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.199 Reference 221. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.200 Reference 222. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was processing 22 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (PA DER) and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned a C rating. The isokinetic factor for two of the three runs exceeded 110 percent. The problem was traced to the delta H gauge which was reading approximately 10 percent high.

4.2.1.201 Reference 223. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for back-half filterable PM, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, and the test methodology was sound.

4.2.1.202 Reference 224. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.203 Reference 225. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.204 Reference 226. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. The test included measurements of trace metals (arsenic, beryllium, cadmium, copper, mercury, manganese, nickel, lead, selenium, and zinc), hexavalent and total chromium, PAH, formaldehyde, benzene, CO_2, SO_2, ozone (O_3), and NO_x. These pollutants (except for O_3) were measured using EPA reference test methods or CARB equivalent methods.

The test data (except for O_3) are assigned an A rating. The report includes adequate detail, the test methodology was sound and no problems were reported. The O_3 data are assigned a D rating because the methodology was not described in detail (although the report specified the use of CEM) and EPA has not validated the use of CEM for measuring O_3.

4.2.1.205 Reference 229. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Particulate matter (particle size analysis), CO_2 (with a Fyrite analyzer for CO_2 analysis), CO, and NOx emissions were measured at the fabric-filter outlet. These pollutants were measured using CARB Methods 501 and 100. The particle size analysis was performed with a cascade impactor, and the particle size data are used to calculate filterable PM, PM-10, PM-2.5, and PM-1 emission factors. Three test runs were conducted for CO and NOx. Two test runs were conducted for all other pollutants.

The CO and NOx data are rated A. The CO_2 data are assigned a B rating because a Fyrite gas analyzer was used. The PM test data are assigned a B rating because only two test runs were conducted. The test methodology was sound, the report contained sufficient detail, and no problems were reported.

4.2.1.206 Reference 231. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified) and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 237 and 238. The filterable PM data are not used for emission factor development because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.207 Reference 232. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified) and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 233 through 235. The filterable PM data are not used for emission factor development because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.208 Reference 233. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified) and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 232, 234, and 235. The filterable PM data are not used for emission factor development because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.209 Reference 234. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified) and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 232, 233, and 235. The filterable PM data are not used for emission factor development because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.210 Reference 235. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified) and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 232 through 234. The filterable PM data are not used for emission factor development because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.211 Reference 236. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 10 percent RAP during testing. Filterable PM, CO_2, and VOC emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (modified), 3, and 25, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for PM and CO_2. Two valid test runs were conducted for VOCs.

The PM and CO_2 test data are assigned an A rating. The VOC data are assigned a D rating because a positive bias in Method 25 results may occur when the product of the moisture content and CO_2 concentration of the stack gas is greater than 100, which was the case during all of the test runs. Also, only two of the Method 25 test runs were valid. The report contained adequate detail, the test methodology was sound (except as noted), and no problems were reported.

4.2.1.212 Reference 237. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. One test run was conducted for each pollutant. The facility tested is the same facility described in References 231 and 238. The filterable PM data are not considered valid because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.213 Reference 238. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. One test run was conducted for each pollutant.

The facility tested is the same facility described in References 231 and 237. The filterable PM data are not considered valid because a modified method was used (no filter until after the impingers).

The CO_2 test data are assigned a C rating because only one test run was conducted.

4.2.1.214 Reference 239. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant, but two of the PM measurements were not valid because two test runs did not satisfy the Method 5 isokinetic requirements.

The PM test data are assigned a C rating because only one valid test run was conducted. The CO_2 test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.1.215 Reference 240. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.216 Reference 241. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and TOC (as propane) emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5, 3A, and 25A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop is 14 in w.c.. The facility tested is the same facility described in Reference 242. However, prior to the test described in Reference 242, the venturi scrubber was replaced with a fabric filter.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.217 Reference 242. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, and TOC (as propane) emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3A, and 25A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant. The facility tested is the same facility described in Reference 241. However, following the test described in Reference 241, the venturi scrubber was replaced with a fabric filter.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.218 Reference 243. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 (with a Fyrite analyzer for CO_2 analysis) emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 14-15 in w.c..

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.219 Reference 244. This reference documents an emission test conducted on a natural gas-fired, continuous-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.220 Reference 245. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Four test runs were conducted for each pollutant. After the second test run, plant personnel found that a bag in the baghouse had slid off the cage, leaving a hole in the tube sheet through which particulate was being emitted. Therefore, the PM data from Runs 1 and 2 are not valid. The facility tested is the same facility described in References 246 and 247.

The filterable PM test data are assigned a B rating because only two valid test runs were conducted. The CO_2 test data are assigned an A rating. The report includes adequate detail, and the test methodology was sound.

4.2.1.221 Reference 246. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 7 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in References 245 and 247, but a different fuel was used during this test.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.222 Reference 247. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant. The facility tested is the same facility described in References 245 and 246.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.223 Reference 248. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.224 Reference 249. This reference documents an emission test conducted on a counter-flow, No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an B rating. Only the average process rate is reported. The test methodology was sound, and no problems were reported.

4.2.1.225 Reference 250. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.226 Reference 251. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant. The pressure drop across the venturi scrubber is 20 in. w.c..

The test data are assigned an B rating because only an average process rate was provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.227 Reference 252. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 20 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an B rating because only an average process rate was provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.228 Reference 253. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.229 Reference 254. This reference documents an emission test conducted on a counter-flow, propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 20 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, CO, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses), 10, and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an B rating because only an average process rate was provided in the report. The test methodology was sound and no problems were reported.

4.2.1.230 Reference 255. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, CO_2, and SO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Method 5, 3 (with a Fyrite analyzer), and a modified Method 8 (back-half of the Method 5 train) with a barium perchlorate and thorin titration). The scrubber pressure drop was 11.2 in. w.c.. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned a B rating because the first test run was outside of the acceptable isokinetic range. The SO_2 test data are assigned an A rating. The test methodology was sound and no other problems were reported.

4.2.1.231 Reference 256. This reference documents an emission test conducted on a batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3A, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound and no problems were reported.

4.2.1.232 Reference 257. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound and no problems were reported.

4.2.1.233 Reference 258. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 14 in. w.c.. The filterable PM data from Run 3 are not valid because the test did not satisfy the Method 5 isokinetic requirements.

The filterable PM test data assigned a B rating because only two valid test runs were conducted. The CO_2 test data are assigned an A rating. The test methodology was sound and no problems were reported.

4.2.1.234 Reference 259. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 10 in. w.c..

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.235 Reference 260. This reference documents an emission test conducted on a drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned a C rating because the fuel type was not specified. The test methodology was sound and no problems were reported.

4.2.1.236 Reference 261. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses), and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a B rating because the report only includes an average production rate. The test methodology was sound, and no problems were reported.

4.2.1.237 Reference 262. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing 11 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses), and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 20 in. w.c..

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.238 Reference 263. This reference documents an emission test conducted on a propane-fired batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.239 Reference 264. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a cyclone/fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.240 Reference 265. This reference documents an emission test conducted on a reprocessed No. 4 fuel oil-fired, batch-mix dryer controlled by a cyclone/fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.241 Reference 266. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 11 in. w.c..

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.242 Reference 267. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.243 Reference 268. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was processing 10 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses), and 3A, respectively. Three test runs were conducted for each pollutant, but a process upset invalidated the Run 1 test results. The venturi scrubber pressure drop was 21 in. w.c..

The test data are assigned a B rating because only two valid test runs were conducted and only an average process rate was provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.244 Reference 269. This reference documents an emission test conducted on a counter-flow, No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report includes adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.245 Reference 270. This reference documents an emission test conducted on a batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound, and no problems were reported.

4.2.1.246 Reference 271. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

Reference 273 This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.247 Reference 274. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.248 Reference 275. This reference documents an emission test conducted on a #4 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. Test run three was completed with a leak rate slightly above the allowable set by the method. The dry gas volume was corrected according to paragraph 6.5 of Method 5. No other problems were encountered.

The test data are assigned a B rating because of the leak that was detected in Run 3. The report contained adequate detail, and the test methodology was sound.

4.2.1.249 Reference 276. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Two test runs were conducted for each pollutant.

The test data are assigned an B rating because only two test runs were conducted. The test methodology was sound, and no problems were reported.

4.2.1.250 Reference 277. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test run for the facility documented in Reference 276. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.251 Reference 278. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test run for the facility documented in References 276 and 277. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.252 Reference 279. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test run for the facility documented in references 276, 277, and 278. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.253 Reference 280. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Two test runs were conducted for each pollutant.

The test data are assigned a B rating because only two test runs were conducted. No problems were reported.

4.2.1.254 Reference 281. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.255 Reference 282. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, CO_2, and CO emissions were measured at the fabric-filter outlet. These pollutants were measured using Methods ST-15 (front- and back-half analyses), ST-5, and ST-6 which according to a phone conversation with Chuck McClure from the Bay Area Air Quality Management District are equivalent to EPA Methods 5, 3, and 10, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.256 Reference 283. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an B rating because only an average production rate was provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.257 Reference 284. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. The sampling train was modified to use a front- and back-half filter. The back-half filter was placed between the third and fourth impinger. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.258 Reference 285. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test for the facility documented in reference 284. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.259 Reference 286. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted for each pollutant. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.260 Reference 287. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test for the facility documented in Reference 286. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.261 Reference 288. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District

Method 5 testing guidelines. One test run was conducted for each pollutant. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.262 Reference 289. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. The EPA Method 5 sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. One test run was conducted as a renewal test for the facility documented in Reference 288. The filterable PM data are not used for emission factor development because a modified sampling train was used (no front-half filter).

The CO_2 test data are assigned a C rating because only one test run was conducted. No problems were reported.

4.2.1.263 Reference 290. This reference documents an emission test conducted on an asphalt plant with a batch-mix dryer, controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 5 in. w.c..

The test data are assigned a C rating because only an average production rate was reported and the fuel used to fire the dryer was not specified. The test methodology was sound, and no problems were reported.

4.2.1.264 Reference 291. This reference documents an emission test conducted on an asphalt plant with a batch-mix dryer, controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 5 in. w.c..

The test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound and no problems were reported.

4.2.1.265 Reference 292. This reference documents an emission test conducted on a fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The test report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.266 Reference 293. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The test report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.267 Reference 294. This reference documents an emission test conducted on a propane-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The test report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.268 Reference 295. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 30 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The test report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.269 Reference 296. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using Method ST-15 and ST-24, respectively. According to Mr. Chuck McClure of the Bay Area Air Quality Management District these methods are equivalent to EPA Methods 5 and 3. Carbon monoxide emissions also were measured, but the sampling and analysis method is not specified in the report. Three test runs were conducted for each pollutant.

The PM and CO_2 test data are assigned a B rating because the test report did not provide sufficient detail, and only an average process rate was provided. The CO test data are assigned a D rating because the test method is not specified in the report. No problems were reported.

4.2.1.270 Reference 297. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The test report contained adequate detail and the test methodology was sound.

4.2.1.271 Reference 298. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.272 Reference 299. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing about 21 percent RAP during testing. Sulfur dioxide emissions were measured at the fabric-filter outlet using EPA Method 6. Three test runs were conducted. A neutralizing agent was used in the drum to reduce SO_2 emissions.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.273 Reference 300. This reference documents an emission test conducted on a No. 6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, CO_2, and SO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3, and 8, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a B rating because only an average production rate was provided in the report. The test methodology was sound, and no problems were reported.

4.2.1.274 Reference 301. This reference documents an emission test conducted on a No. 4-6 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 24 percent RAP for the first two runs and zero percent RAP for the third run. Filterable PM, CO_2, HCl, Cd, Cr, and lead emissions were measured at the fabric-filter outlet. These pollutants were measured using standard EPA Methods according to the test report, but the methods were not specified by number. Three test runs were conducted for each pollutant.

The test data are assigned an B rating since the report did not state the exact test methods used. The test methodology appeared to be sound, and no problems were reported.

4.2.1.275 Reference 302. This reference documents an emission test conducted on a No. 2 fuel oil-fired, counter-flow, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contains adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.276 Reference 303. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contains adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.277 Reference 304. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant. The filterable PM data from Run 3 are not considered valid because the test did not satisfy the Method 5 isokinetic requirements.

The filterable PM data are assigned a B rating because only two valid test runs were conducted. The CO_2 data are assigned an A rating. The report contains adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.278 Reference 306. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. One test run was conducted for each pollutant. The PM data are not used for emission factor development because a modified sampling train was used (no front-half filter). The venturi scrubber pressure drop was not given. This is the same facility documented in Reference 307.

The CO_2 test data are assigned a C rating because only one test run was conducted. The test methodology was sound, and no problems were reported.

4.2.1.279 Reference 307. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a venturi scrubber. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. One test run was conducted for each pollutant. The PM data are not used for emission factor development because a modified sampling train was used (no front-half filter). The venturi scrubber pressure drop was not given. This is the same facility documented in Reference 306.

The CO_2 test data are assigned a C rating because only one test run was conducted. The test methodology was sound, and no problems were reported.

4.2.1.280 Reference 308. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. This is the same facility documented in Reference 312. However, during the test described in Reference 312, No. 2 fuel oil was used to fire the dryer.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.281 Reference 309. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.282 Reference 310. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for filterable PM and CO_2, but only two runs included condensable inorganic PM measurements. This is the same facility documented in Reference 313.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The condensable inorganic PM data are assigned a B rating because only two runs were conducted. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.283 Reference 311. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.284 Reference 312. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. This is the same facility documented in Reference 308. However, during the test described in Reference 308, natural gas was used to fire the dryer.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.285 Reference 313. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. This is the same facility documented in Reference 310.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.286 Reference 314. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.287 Reference 315. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM, CO_2, and lead emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3 (with a Fyrite analyzer for CO_2 analysis), and 12, respectively. Three test runs were conducted for each pollutant.

The filterable PM and lead data are assigned a B rating because only two valid runs were conducted. The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The report included adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.288 Reference 316. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.289 Reference 317. This reference documents an emission test conducted on a No. 4 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, lead, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 12, and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. Two of the three lead runs were non-detect, and emissions for these runs are estimated as one-half of the detection limit.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The lead test data are assigned a C rating because lead was not detected during two of the test runs. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.290 Reference 318. This reference documents an emission test conducted on a No. 4 waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, lead, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 12, and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. Lead was not detected during any test run, and emissions are estimated as one-half of the detection limit

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The lead test data are assigned a C rating because lead was not detected during any test run. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.291 Reference 319. This reference documents an emission test conducted on a No. 4 fuel oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, lead, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 12, and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant. Lead was not detected during any test run, and emissions are estimated as one-half of the detection limit

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The lead test data are assigned a C rating because lead was not detected during any test run. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.292 Reference 320. This reference documents an emission test conducted on an off specification waste oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.293 Reference 321. This reference documents an emission test conducted on an off specification oil-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, lead, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 12, and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Three test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM and lead test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.294 Reference 322. This reference documents an emission test conducted on a No. 4 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA method 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 23 in. w.c..

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.295 Reference 323. This reference documents an emission test conducted on a No. 2 fuel oil-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (as modified by PADER) and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.296 Reference 324. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 10.7 in. w.c.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.297 Reference 325. This reference documents an emission test conducted on a batch-mix dryer (fuel not specified) controlled by a fabric filter. The facility was processing 10 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound and no problems were reported.

4.2.1.298 Reference 326. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.299 Reference 327. This reference documents an emission test conducted on a propane-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.300 Reference 328. This reference documents an emission test conducted on a natural gas-fired, batch-mix dryer controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.301 Reference 329. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.302 Reference 330. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a fabric filter. The facility was processing 13 percent RAP during testing. Filterable PM, condensable inorganic PM, condensable organic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3A, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a B rating because only an average production rate was reported. The test methodology was sound and no problems were reported.

4.2.1.303 Reference 331. This reference documents an emission test conducted on a batch-mix dryer (unspecified fuel) controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM, condensable inorganic PM, and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 (front- and back-half analyses) and 3, respectively. Three test runs were conducted for each pollutant.

The test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound and no problems were reported.

4.2.1.304 Reference 332. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 6.2 in. w.c.. This is the same facility documented in Reference 333.

The test data are assigned an A rating. The test methodology was sound and no problems were reported.

4.2.1.305 Reference 333. This reference documents an emission test conducted on a natural gas-fired, drum-mix dryer controlled by a venturi scrubber. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the venturi scrubber outlet. These pollutants were measured using EPA method 5 and 3, respectively. Three test runs were conducted for each pollutant. The venturi scrubber pressure drop was 7.15 in. w.c.. This is the same facility documented in Reference 332.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.306 Reference 334. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3 (with a Fyrite analyzer for CO_2 analysis), respectively. Five test runs were conducted for each pollutant.

The CO_2 test data are assigned a B rating because a Fyrite analyzer was used. The filterable PM test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.307 Reference 335. This reference documents an emission test conducted on parallel-flow drum-mix dryer (unspecified fuel) controlled by a fabric filter. Data on RAP processing are not provided in the report. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Method 5, as modified by PADER, and Method 3, respectively. Weights are recorded for soluble and insoluble back-half particulate, but the analysis method does not appear to be comparable to EPA approved methodology for determining condensable PM emissions. Therefore, the condensable PM data were not used to develop emission factors. Three test runs were conducted for each pollutant.

The filterable PM and CO_2 test data are assigned a C rating because the fuel used to fire the dryer was not specified. The test methodology was sound and no problems were reported.

4.2.1.308 Reference 336. This reference documents an emission test conducted on a coal- and natural gas-fired, batch-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM and CO_2 emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5 and 3, respectively. Three test runs were conducted for each pollutant. The filterable PM data from Run 2 are not valid because the test did not satisfy the Method 5 isokinetic requirements.

The filterable PM test data are assigned a B rating because only two valid test runs were conducted. The CO_2 data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.309 Reference 337. This reference documents an emission test conducted on a No. 2 fuel oil-fired, drum-mix dryer controlled by a fabric filter. The facility was not processing RAP during testing. Filterable PM, CO_2, PAH, and TOC emissions were measured at the fabric-filter outlet. These pollutants were measured using EPA Methods 5, 3 (with an Orsat analyzer), 23, and 25A, respectively. Three test runs were conducted for each pollutant, and production rates were provided for each test run. The PAH test indicated that naphthalene was the primary PAH emitted from the source. Acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, and chrysene also were detected by all three test runs. Benzo(a)anthracene was detected during one test run, and no other PAH were detected.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.310 Reference 338. This reference was deleted and the reference number is not used.

4.2.1.311 Reference 339 (Plant A). This reference documents an emission test conducted on a continuous, counter-flow, double-barrel, rotary drum-mix dryer fired with recycled No. 2 fuel oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 23 percent RAP during three of the four test runs (Runs 1 through 3). The fourth test run was conducted while the facility was processing only virgin aggregate. The test included measurements of filterable particulate matter (PM), polychlorinated dibenzo-*p*-dioxins (PCDDs or dioxins), polychlorinated dibenzofurans (PCDFs or furans), trace metals, speciated organic compounds, total hydrocarbons (called total organic compounds [TOC] for the remainder of this document), carbon monoxide (CO), and sulfur dioxide (SO_2) at the fabric-filter inlet and outlet.

Dioxins and furans were sampled at the fabric-filter inlet and outlet using EPA Method 23. The inlet emission data were not rated and were not used to develop emission factors, as the report identifies the inlet tests as not valid due to low sample volume of about 11 dry standard cubic feet and a short sample duration of 20 minutes. The sampling was aborted due to sampling difficulties associated with high PM grain loadings at the fabric-filter inlet. As a result of the sampling difficulties, only one inlet sample run was attempted. Although the sample volume was low, 19 out of 25 congeners had reported values. However, since only one sample run was attempted, the inlet data were not used for emission factor development since another test had multiple runs with reported values. Three tests with RAP and one without RAP were performed at the fabric-filter outlet. These data do not indicate any difference in PCDD or PCDF emissions associated with processing of RAP. Therefore, the data from all four outlet test runs were combined to develop an average emission factor for each specific PCDD and PCDF compound that was quantified.

Filterable PM and trace metals emissions were sampled using EPA Method 29. The testing initially included simultaneous measurements at the inlet and outlet of the fabric filter. However, the grain loading at the fabric-filter inlet far exceeded the sampling capacity of the sampling trains. As a result, attempts to measure fabric-filter inlet PM and trace metals emissions were discontinued. The PM and metals testing that was completed at the fabric-filter inlet is not considered valid. During production with RAP, beryllium was not detected during any of the sampling runs, cobalt was detected only during the first run, and silver and thallium were detected during two of the sampling runs. There were two instances where the target metal was detected, but was present at a concentration less than the concentration detected in the reagent blank samples. In these two cases (silver during the second run and antimony during the third run), a value of zero has been reported. Similarly, during production without RAP, antimony, silver, and selenium were detected at quantities below the concentration in the reagent blanks. For these three metals, values of zero have been reported. In general, the metals emissions measured during the non-RAP test run (Run 4) were slightly lower than during Runs 1 through 3. However, the results of the RAP and non-RAP testing are similar and the data from all four test runs were combined to calculate average emission factors for each metal. Visible emissions (VE) observations also were conducted using EPA Method 9, but VE data are not useful for emission factor development.

The following speciated organic compounds were measured using EPA Method 320 (Fourier Transform Infrared Spectroscopy [FTIR]): toluene, hexane, ethylene, methane, formaldehyde, 3-methylpentane, isooctane, butane, 2-methyl-1-pentene, heptane, 1-pentene, and 2-methyl-2-butene. Carbon monoxide and SO_2 also were measured by EPA Method 320. A single FTIR instrument was used to measure emissions from both the fabric-filter inlet and outlet. During each of four test runs, the sampling location was moved between the inlet and outlet several times. In addition, during Runs 3 and 4, the sample was processed in a condenser prior to analysis, in order to detect as many compounds as possible. After examining the data, it was determined that all of the measurements, regardless of sampling location or condenser use, should be averaged together to calculate a single emission rate for each test run. This decision is based on: (1) the expectation that a fabric filter does not provide any control of the pollutants measured by FTIR and (2) an examination of the data that showed similar emission levels at the fabric-filter inlet and outlet and regardless of condenser use. One exception to this methodology for combining the data is that the post-condenser formaldehyde data are not used because of the high solubility of formaldehyde. Test runs where the target pollutant was not detected were assigned a value of zero.

Total organic compound emissions were measured at the fabric-filter inlet and outlet using EPA Method 25A. Because fabric filters are not expected to reduce TOC emissions, the fabric-filter inlet and outlet data were combined to determine average emissions for each test run. The results are presented on an “as propane” basis.

A rating of A was assigned to most of the data (except for the inlet Method 23 and Method 29 data, which are not rated), unless more than one test run did not detect the targeted pollutant. In such cases, the data were assigned a B rating. In some cases, the dioxin and furan test run values are estimates; where more than one test run was an estimated value, these emission data also were assigned a B rating. Similarly, if the combination of non-detect and estimated runs was two or more, the data were assigned a B rating. The report included substantial detail, the methodology was sound, and no problems were reported (except as noted above).

4.2.1.312 Reference 340 (Plant B). This reference documents an emission test conducted on a continuous, parallel-flow, drum-mix dryer fired with No. 2 fuel oil. Emissions from the dryer are controlled by a knockout box followed by a fabric filter. The facility was processing about 18 percent RAP during two of the three test runs (Runs 1 and 2). The third test run was conducted while the facility was processing only virgin aggregate. The test included measurements of filterable PM, dioxins and furans, speciated organic compounds, CO, SO_2, total organic compounds, and trace metals at the fabric-filter inlet and outlet.

Emissions of PCDDs and PCDFs were sampled at the fabric-filter inlet and outlet using EPA Method 23. The vast majority of congeners were not detected at either location during all three test runs. Due to the extremely high grain loading at the baghouse inlet location, the Method 23 sampling train was significantly modified and the Method 29 sampling runs significantly shortened for two test runs. Even with the Method 23 modifications, the high inlet grain loading made it necessary to change the filters frequently during the sampling runs. A comparison of the fabric-filter inlet and outlet data showed that the fabric filter achieved considerable reduction of PCDDs and PCDFs. Because of uncertainties associated with the modifications to the test method (at the fabric-filter inlet), the large difference in the non-detect values for two of the three runs and the high detection limits for these two runs; a value of half the non-detect value from these two fabric-filter inlet test data for PCDDs and PCDFs was averaged with a measured or estimated maximum value if this value was less than the value measured. At the outlet of the baghouse, no modifications of the Method 23 sampling train were required. However, of the 25 target congeners, only total TCDF was quantified during one run and total HxCDD was quantified during another run. Additionally, for the runs where one congener was quantified, an Estimated Maximum Possible Concentration (EMPC) value could be assigned to one additional congener for one run and to seven congeners for the other run. The third run had only one congener with an EMPC value. Although the majority of the congeners were not detected, the detection limits for all of the congeners were significantly higher than the measured values at Plant A. Test runs (most of the test runs) where the target pollutant was not detected were assigned a value of half the detection limit. When this value was lower than a value reported as measurable, it was included to develop the average emission factor for that congener. The data do not indicate any difference in dioxin or furan emissions associated with processing of RAP. Therefore, the data from all three outlet test runs were combined to develop an average emission factor for each specific PCDD and PCDF compound that was quantified.

Filterable PM and trace metals emissions were sampled using EPA Method 29. Antimony, beryllium, and mercury were not detected during any of the inlet sample runs. Selenium was detected during one inlet sample run (Run 3). Arsenic, beryllium, cobalt, mercury, and thallium were not detected in any of the outlet sample runs. In addition, silver was not detected in the third outlet test run. Test runs where the target pollutant was not detected were assigned a value of zero. Visible emissions observations also were conducted using EPA Method 9, but VE data are not useful for emission factor development.

The following speciated organic compounds were measured using EPA Method 320 (FTIR): toluene, hexane, ethylene, methane, formaldehyde, 3-methylpentane, isooctane, heptane, 1-pentene, 2-methyl-2-butene, and n-pentene. Carbon monoxide and SO_2 also were measured by EPA Method 320.

A single FTIR instrument was used to measure emissions from both the fabric-filter inlet and outlet. During each of the three test runs, the instrument was moved between the inlet and outlet several times. During portions of all three runs, the sample was processed in a condenser prior to analysis, in order to detect as many compounds as possible. After examining the data, it was determined that all of the measurements, regardless of sampling location or condenser use, should be averaged together to calculate a single emission rate for each test run. This decision is based on: (1) the expectation that a fabric filter does not provide any control of the pollutants measured by FTIR and (2) an examination of the data that showed similar emission levels at the fabric-filter inlet and outlet and regardless of condenser use. One exception to this methodology for combining the data is that the post-condenser formaldehyde data are not used because of the high solubility of formaldehyde. Test runs where the target pollutant was not detected were assigned a value of zero.

Total organic compound emissions were measured at the fabric-filter inlet and outlet using EPA Method 25A. Because fabric filters are not expected to reduce TOC emissions, the fabric-filter inlet and outlet data were combined to determine average emissions for each test run. The results are presented on an "as propane" basis.

A rating of A was assigned to most of the test data, unless more than one test run did not detect the targeted pollutant, in which case the data were assigned a B rating. A rating of B was assigned to most of the dioxin/furan data, because most of the test runs did not detect the targeted pollutant, or the reported values are estimates. The report included substantial detail, the methodology was sound, and no problems were reported (except as documented above).

4.2.1.313 Reference 341. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 percent RAP during the emission test. The test included measurements of filterable PM, formaldehyde, benzene, CO, CO_2, and NO_x at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant. The report does not specify the method used to measure benzene, CO, or NO_x emissions.

The PM, formaldehyde, and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO, NO_x, and benzene data were not rated because the test methods were not specified in the report.

4.2.1.314 Reference 342. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 percent RAP during the emission test. The test included measurements of filterable PM, formaldehyde, CO, CO_2, and NO_x at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant. The report does not specify the method used to measure CO or NO_x emissions.

The PM, formaldehyde, and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO and NO_x, data were not rated because the test methods were not specified in the report.

4.2.1.315 Reference 343. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 23 percent RAP during the emission test. The test included measurements of filterable PM, formaldehyde, CO_2, benzene, chlorobenzene, and dichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. The report does not specify the method used to measure benzene, chlorobenzene, or dichlorobenzene emissions. Three test runs were conducted for each pollutant.

The PM, formaldehyde, and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The benzene, chlorobenzene, and dichlorobenzene data were not rated because the test method was not specified in the report.

4.2.1.316 Reference 344. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 24 percent RAP during the emission test. The test included measurements of filterable PM, formaldehyde, CO, NO_x, CO_2, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. The report does not specify the method used to measure CO, NO_x, or benzene emissions. Three test runs were conducted for each pollutant.

The PM, formaldehyde, and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO, NO_x, and benzene data were not rated because the test methods were not specified in the report.

4.2.1.317 Reference 345. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 10 percent RAP during the emission test. The test included measurements of filterable PM, SO_2, CO_2, benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were measured using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 18 was used to quantify benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit in all test runs.

The PM, SO_2, CO_2, and benzene data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.318 Reference 346. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 24 percent RAP during the emission test. The test included measurements of filterable PM, CO, CO_2, NO_x, formaldehyde, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17, and CO_2 concentrations were measured by Orsat. The report does not specify the method used to measure CO, NO_x, formaldehyde, or benzene emissions. Three test runs were conducted for each pollutant.

The PM and CO_2 data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO, NO_x, formaldehyde, and benzene data are not rated because the test methods were not specified.

4.2.1.319 Reference 347. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The mix did not contain RAP during the emission test. The test included measurements of filterable PM, CO, CO_2, NO_x, formaldehyde, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; and Method 0011 was used to quantify formaldehyde emissions. The report does not specify the method used to measure CO, NO_x, or benzene emissions. Three test runs were conducted for each pollutant.

The PM, CO_2, and formaldehyde data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO, NO_x, and benzene data are not rated because the test methods were not specified.

4.2.1.320 Reference 348. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The mix did not contain RAP during the emission test. The test included measurements of filterable PM, CO, CO_2, NO_x, HCl, formaldehyde, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; Method 26 was used to measure HCl emissions; benzene emissions were quantified by Method 18; and Method 0011 was used to quantify formaldehyde emissions. The report does not specify the method used to measure CO or NO_x. Three test runs were conducted for each pollutant.

The PM, CO_2, HCl, benzene, and formaldehyde data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The CO and NO_x data are not rated because the test methods were not specified.

4.2.1.321 Reference 349. This reference documents an emission test conducted on a continuous rotary drum-mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 percent RAP during the emission test. The test included measurements of filterable PM, condensable PM, CO_2, formaldehyde, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; Method 0011 was used to quantify formaldehyde emissions; and benzene emissions were measured by Method 18. The report indicates that condensable PM emissions were quantified according to Wisconsin Department of Natural Resources procedures, which are comparable to the procedures specified in EPA Method 202. Three test runs were conducted for each pollutant.

The data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.322 Reference 350. This reference documents an emission test conducted on a continuous rotary drum-mix dryer fired with a combination of drain oil and natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 percent RAP during the emission test. The test included measurements of filterable PM, CO_2, SO_2, sulfuric acid (H_2SO_4), benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; SO_2 and H_2SO_4 emissions were measured by Method 6; and benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions were measured by Method 18. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit in all test runs.

The data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.323 Reference 351. This reference documents an emission test conducted on a parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 10 percent RAP during the emission test. The test included measurements of filterable PM, CO_2, SO_2, sulfuric acid (H_2SO_4), benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; SO_2 and H_2SO_4 emissions were measured by Method 6; and benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions were measured by Method 18. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit in all test runs.

The data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.324 Reference 352. This reference documents an emission test conducted on a continuous, rotary drum-mix dryer. Two 1-hour tests were performed. During the first test the mixer was fired with No. 5 fuel oil, and, during the second test, the mixer was fired with No. 2 fuel oil. The facility was processing an unspecified amount of RAP during the emission test. Emissions from the dryer are controlled by a fabric filter. The test included measurements of NO_x and CO_2. Emissions of NO_x were quantified using a continuous emission monitor (CEM) (presumably in accordance with EPA Method 6E), and CO_2 concentrations also were measured using a CEM.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.325 Reference 353. This reference documents an emission test conducted on a continuous, rotary drum-mix dryer that was fired with No. 5 fuel oil. Emissions from the dryer are controlled by a fabric filter. The report does not indicate if the mix included RAP during the emission test. The test included measurements of NO_x, TOC, and CO_2. Emissions of NO_x were quantified using EPA Method 7E and TOC was measured by EPA Method 25A; CO_2 concentrations also were measured using a CEM. Three 1-hour runs of continuous sampling were performed.

The NO_x and CO_2 test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. A hand-written note in the report states that the TOC data are incorrect and that the corrected data were not included. For that reason, the TOC data were not rated.

4.2.1.326 Reference 354. This reference documents an emission test conducted on a continuous, rotary drum-mix dryer that was fired with low sulfur No. 2 fuel oil. The sulfur content of the fuel was 0.26 percent. Emissions from the dryer are controlled by a fabric filter. The report does not indicate if the mix included RAP during the emission test. The test included measurements of filterable PM, NO_x, and CO_2. Filterable PM emission were measured by EPA Method 5; emissions of NO_x were quantified using EPA Method 7E; and CO_2 concentrations also were measured by Orsat. Three 1-hour test runs were performed.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.327 Reference 355. This test program quantified emissions from the HMA load-out operations, silo exhaust, and drum-mix dryer. A background test also was performed (no asphalt loading) to provide a measure of the contribution of truck emissions to the measured load-out emissions. The testing was sponsored by EPA and was a cooperative effort between EPA, a citizen's group, State agencies and industry. The emissions testing was performed by Midwest Research Institute (MRI) and Pacific Environmental Services (PES) (both under contract to EPA) in July 1998. In addition, an independent Technical Systems Audit of the procedures used by both contractors was performed by Research Triangle Institute under contract to EPA. Cooperation between EPA, the citizen's group, and industry continued through the draft and final reporting processes. A large number of citizen and industry comments on the MRI and PES draft reports led EPA to prepare a detailed and sometimes non-typical analysis of the emissions data, which was compiled into the "Response to Comments" document (Reference 389). Due to the high level of documentation included in the test reports; the adherence to EPA Reference test methods; the few problems noted in the Technical Systems Audit Report; and the high level of scrutiny that was included in the development of the test program, implementation of the test, and production of the test report, the data from this report were assigned an A rating, unless noted.

Asphalt Plant C is a continuous, drum-mix HMA production facility located south of Los Angeles, California. The plant was built in 1994 and has a rated production capacity of 650 tons per hour (tons/hr) of hot mix asphalt. Production during the test ranged from 370 tons/hr to 630 tons/hr and averaged 490 tons/hr. For all but one test, the product mix included 30 percent RAP. The average asphalt binder content of the HMA produced was 5.0 percent. Five 200-ton heated storage silos sit on top of a load-out tunnel. The storage silos serve as a holding station between production and the loading of the HMA into transport trucks. A conveyer system carries the fresh asphalt from the secondary chamber of the dryer to the top of the silos and loads one silo at a time. Unlike most HMA plants, asphalt fumes generated in the silos during load-in are vented through an exhaust system on top of the silos. Each of the five silos has its own 10-inch internal diameter (ID) silo exhaust duct that feeds a 12-inch ID common header that carries the asphalt fumes to the tunnel exhaust system. The silo storage testing was performed from an extension at the top of Silo 2, which is located upstream of the connection to the common header. The silo exhaust duct testing was performed only when hot mix asphalt was being loaded into Silo No. 2. Also, unlike most HMA plants, the area beneath the storage silos is enclosed in a tunnel and ventilated. The load-out tunnel is approximately 183 feet long by 16 feet high by 16 feet wide. Attached to the ceiling of the load-out tunnel, and below each of the five silos, is an exhaust plenum that draws air and vapors off the transport trucks and out of the tunnel during load-out. Each of the five exhaust plenums is identical and shaped like a tuning fork with holes in the bottom and slots in the inside legs. Air and vapors from the HMA during load-out are drawn through the holes and slots and into the tunnel exhaust duct by a constant rate induced draft fan. Only one exhaust plenum is in operation at any one time. The load-out and silo storage ventilation systems combine into one common duct which passes through a wet electrostatic precipitator and is exhausted to the atmosphere. Testing for the load-out system was performed at a port located between Silos 1 and 2, which is upstream of the combined common duct. During normal load-out operations, 21 to 25 tons of HMA are transferred in 15 to 30 seconds from the silo to the truck. Testing to characterize emissions from the load-out operations was performed only when HMA was loaded from Silos 2, 3, 4, or 5.

Source sampling was performed in the tunnel exhaust duct and silo exhaust duct to determine the concentrations and mass emission rates of PM, methylene chloride extractable matter (MCEM), and organic HAPs. Four tests at the TED and three tests at the SED were performed over five consecutive days beginning on July 24, 1998. EPA Method 315, "Determination of Filterable Particulate Matter (PM) and Methylene Chloride Extractable Matter (MCEM) Emissions from Stationary Sources," was used to quantify PM and MCEM emissions. Three test methods were used to quantify volatile organic HAPs (VOHAPs). SW-846 Method 0030 in combination with SW-846 Method 8260B (referred to as VOST) was used to quantify a majority of the targeted compounds. EPA Method 18 was used in a backup capacity to quantify benzene, cumene, ethylbenzene, hexane, toluene, o-xylene, m-xylene, and p-xylene. EPA Method 320 (extractive FTIR) was used to quantify higher concentrations of VOHAPs, CO, SO_2, and NO_X. To reduce the spectral interferences due to moisture and CO_2 and to quantify lower concentrations of VOHAPs, an additional EPA Method 320 sample was collected for each run using a sample concentration method. In addition, a third method using a direct interface GC/MS procedure was used as an on-site screening tool and QC check for selected VOHAPs. SW-846 Method 0010, "Modified Method 5 Sampling Train (MM5)," was used to collect semivolatile organic HAPs (SVOHAPs) at both locations. The MM5 samples were extracted following the procedure of SW-846 Method 3542, dated January 1995. The sample extracts were analyzed two ways: 1) in accordance with the guidelines of SW-846 Method 8270C by high resolution gas chromatograph/low resolution mass spectrometer (HCGC/LRMS) for SVOHAPs, and 2) in accordance with the guidelines of CARB Method 429 by high resolution gas chromatograph/high resolution mass spectrometer (HRGC/HRMS) for PAHs. EPA Method 25A was used to quantify TOC using a flame ionization detector (FID).

Concurrent with FTIR testing of the load-out emissions discussed above, capture efficiency testing also was performed. A stable, nonflammable gas (sulfur hexafluoride, or SF_6, was used as the tracer gas. Sample spectra were collected by extractive FTIR, where concentrations were determined and converted to mass emissions over time. These were compared to the measured tracer gas emission rate, allowing duct capture efficiency to be calculated.

Measurements also were made to estimate the PM and MCEM deposition on the inside walls of the TED, the inside walls of the exhaust plenum above Silo No. 2, the inside walls of the SED and on the ceiling of the load-out tunnel downstream of Silo No. 5.

Asphalt cement samples (i.e., hot liquid asphalt) were collected on July 24, 25, 27, and 28, 1998. On July 24, 25, and 27, 1998, three sets of samples were taken. Each sample was analyzed twice for volatile content at 325°F, once following the procedures of ASTM D 1754 - Effects of Heat and Air on Asphalt Materials (Thin Film Oven Test), and a second time following the procedures of ASTM D 2872 - Effects of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test). In addition, the middle sample from each day was analyzed four more times: 1) using ASTM D 1754 with an oven temperature of 300°F; 2) using ASTM D 1754 with an oven temperature of 350°F; 3) using ASTM D 2872 with an oven temperature of 300°F; and 4) using ASTM D 2872 with an oven temperature of 350°F. The results of the standard and additional ASTM D 2872 analyses performed on the asphalt samples obtained at Plant C are presented in Table 4-2. During the emissions tests, the asphalt mix contained an average liquid asphalt content of 5.0 percent, with a range of 4.9 to 5.2 percent.

As mentioned above, a total of three test runs were performed on the load-out process. A fourth test was performed (without asphalt loading) to measure background emissions from the trucks. Simultaneous with the emissions testing activities, a tracer gas release and capture efficiency measurement was performed to allow for adjustment of the data based on the capture efficiency.

<u>Capture efficiency (CE) correction</u> - The Plant C load-out tunnel enclosure did not meet EPA Method 204 criteria for total enclosures, and thus required capture efficiency testing as part of the test program. Controlled SF_6 releases and capture measurements were performed throughout each of the three test runs. The 90 percent Lower Confidence Limit (LCL) technique was used to determine the capture efficiency for each run, as described in EMC GD-035 "Guidelines for Determining Capture Efficiency" dated 1/9/1995 (http://www.epa.gov/ttn/emc/guidlnd/gd-035.pdf) and EMC GD-036 "Revised Capture Efficiency Memorandum" dated 2/7/1995 (http://www.epa.gov/ttn/emc/guidlnd/gd-036.pdf). The measured capture efficiencies were 64 percent, 65 percent, 54 percent and 45 percent , for Runs 1, 2, 3, and 4, respectively. Raw emissions (concentrations for each analyte) for each test run were then corrected by dividing the analyte concentration by the capture efficiency. Deposition data for PM also was corrected for capture efficiency, using a slightly different procedure that is described in greater detail in Section 4.4 below.

4.2.1.328 Reference 356. Plant D is a batch mix facility located in Barre, Massachusetts. The plants maximum production capacity is 255 tons/hr, but under normal operating conditions, the plant produces 150 tons/hr of HMA. Approximately 95 percent of the HMA produced during the testing included 10 percent RAP. The asphalt binder content of the HMA averaged 5.2 percent. This test program only quantified emissions from the HMA load-out operations. The testing was sponsored by EPA and was a cooperative effort between EPA, a number of citizen's groups, State agencies and industry. The emissions testing was performed by MRI and PES (both under contract to EPA) in October 1998. Plant D testing consisted of measurements of TOC by EPA Method 25A, PM measurements by EPA Method 315 and an estimate of PM deposition in the ventilation system and within the enclosure. Prior to conducting the emissions test, a total temporary enclosure was constructed around the load-out station. The enclosure had entrance and exit doors that were closed during truck loading operations and were manually operated by MRI to allow trucks to enter and exit the enclosure. The enclosure was designed, constructed, and operated to satisfy the requirements of a temporary total enclosure as specified in EPA Method 204. It was noted in the test report that the unpaved floor and approaches to the enclosure were watered periodically to minimize emissions from truck movement in and around the load-out area. It was also noted in the report that, for most loading operations, an exhaust system and flexible hosing within the temporary enclosure captured the exhaust from the diesel engines. Because a few trucks had exhaust systems that also heated the truck bed, the exhaust of these trucks could not be captured. As a result, the majority of the truck exhaust was not measured as part of the load-out emissions. Measurements were made to estimate MCEM deposition on the inside walls of the enclosure, and on the inside walls of the exhaust plenum. Due to the high level of documentation included in the test reports; the adherence to EPA Reference test methods; the few problems noted; and the high level of scrutiny that was included in the development of the test program, implementation of the test, and production of the test report, the data from this report were assigned an A rating, unless noted.

In addition to measuring load-out emissions, eight extended sampling periods were performed following load-out operations. These extended sampling periods were an attempt to estimate emissions from loaded trucks sitting in the yard or in transit to a paving site.

Asphalt cement samples (i.e., hot liquid asphalt) were collected on October 5, 6, and 7, 1998. Each sample was analyzed twice for volatile content at 325°F, once following the procedures of ASTM D 1754 - Effects of Heat and Air on Asphalt Materials (Thin Film Oven Test), and a second time following the procedures of ASTM D 2872 - Effects of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test). In addition, the sample was analyzed four more times: (1) using ASTM D 1754 with an oven temperature of 300°F, (2) using ASTM D 1754 with an oven temperature of 350°F, (3) using ASTM D 2872 with an oven temperature of 300°F, and (4) using ASTM D 2872 with an oven temperature of 350°F. The results of the standard and additional analyses performed by ASTM D 2872 on the asphalt samples obtained at Plant D are presented in Table 4-3. During the emissions tests, the asphalt mix had an average liquid asphalt content of 5.2 percent, with a range of 4.5 to 5.7 percent.

4.2.1.329 Reference 357. This reference documents a technique for estimating emissions from hot mix asphalt load-out operations. Fugitive VOC emissions from hot mix asphalt load-out were estimated using mass transfer equations for the flow of air past a plate. The document states that the key parameters that effect emissions are (1) the vapor pressure of the asphalt, (2) the load-out temperature, and (3) the period of time that the hot mix is sitting uncovered in the truck. The document provides emission factors for VOC from HMA load-out of 0.885 lb/ton of product for batch mix plants and 0.380 lb/ton of product for drum-mix plants (plants with hot storage silos).

The document (Reference 357) relies on several key assumptions. In particular, the assumed asphalt vapor pressure of 30 mm Hg is significantly higher than vapor pressures of asphalt (0.2 to 0.8 mm Hg) presented in Figure 1 of an independent review of this load-out emission estimate provided by

Cambridge Environmental Inc., Cambridge, Massachusetts (included with Reference 357). Information developed in Section 4.4.5 of this background report indicates that at a storage temperature of 325°F the vapor pressure at the asphalt surface is less than 0.9 mm Hg. At a vapor pressure of 0.9 mm Hg, the emissions calculated in this document would decrease by 97 percent. Another assumption used in this document (Reference 357) was the use of the molecular weight of anthracene (C14H10, 178 g/g-mole) as the molecular weight of the VOC emitted from load-out operations. Data from Reference 355 indicate that emissions from asphalt operations are dominated by compounds that have infrared spectra similar to aliphatic hydrocarbons between pentane (MW = 72 g/g-mole) and nonane (MW = 129 g/g-mole). At a molecular weight of 129 g/g-mole, the emissions calculated with this document (Reference 357) would decrease by an additional 28 percent. Information developed in Section 4.4.5 of this background report indicates that a molecular weight of 105 g/g-mole is required to produce emissions with the TANKS program that are consistent with emissions derived from Reference 355. At this molecular weight, the emissions calculated in this document (Reference 357) would decrease by an additional 41 percent. Adjusting for these two factors (vapor pressure and molecular weight) does result in calculated emissions that are consistent with load-out emissions measured in Reference 355 and 356. This analysis is presented later in Section 4.4.1. This document (Reference 357) also relies on a mass transfer equation that relates emissions to the exposed surface area. The exposed surface area used in the document is the surface area of the asphalt pile in the truck bed. The actual exposed surface area during load-out operations is significantly greater than the static surface area used in the document. The document further relies on a constant rate of emissions from the asphalt. However, differences in emissions due to the variations in load-out times for the two processes are not supported by the information derived from test data in References 355 and 356. This information is presented later in Section 4.4.1. As a result, the concerns raised by the various critiques of the methodology used in the document are affirmed by analysis of the data in References 355 and 356 (see Section 4.4.1).

The information presented in the document are not rated for use in developing emission factors for AP-42. This document provides valuable background information and emphasizes the need for emission testing to quantify fugitive emissions from HMA load-out operations.

4.2.1.330 Reference 358. This document include the results of a pretest survey and screening to determine the type and relative magnitude emissions from load-out prior to the full-scale load-out emission test conducted at Plant C and documented in Reference 355. Emissions were sampled using EPA Method 5 and SW846 Method 0030. However, because the purpose of the test was to screen emissions, rather than to quantify emissions, some shortcuts were taken in the sampling procedures. Most notably, only a single traverse was performed and no field blanks were sampled (for the Method 0030 test). The document presents the results of the test but does not include most of the supporting documentation. Because the test was for screening purposes, test methods were simplified, and a subsequent full-scale test was performed on the same sources (as documented in Reference 355), the results of the test are neither presented in this report nor are they incorporated in the revised AP-42 section.

4.2.1.331 Reference 359. This document summarizes the results of a study to determine ambient concentrations of benzene, toluene, ethyl benzene, and total xylenes (BTEX) associated with the filling of liquid asphalt storage tanks. The data were collected on April 23, 1998 by the North Carolina Division of Air Quality (NCDAQ) Air Toxics Analytical Support Team (ATAST). Ambient samples were collected at five locations: an open liquid asphalt railcar hatch, a liquid asphalt storage tank vent during loading, an upwind site, a downwind site, and an adjacent residential site. Samples were analyzed onsite using an organic vapor analyzer and a portable gas chromatograph/mass spectrometer (GC/MS). In addition, samples were collected in SUMMA canisters and subsequently analyzed at the DAQ Toxic Protection Lab using a GC/MS. These samples also were analyzed for compounds other than BTEX. The results of the sampling is discussed further in the following paragraphs. The report concluded that the concentrations of benzene, toluene, and xylene measured at the upwind, downwind, and residential sites were typical of urban air.

The SUMMA cannister samples collected at the railcar hatch and storage tank vent had concentrations beyond the calibration range of the GC/MS and could not be quantified. Table 4-4 shows the results of the analysis of the SUMMA cannister samples. For the data that could be quantified. Toluene and xylenes were detected in the parts per billion by volume (ppbv) range at the upwind, downwind, and residential sites; benzene was detected at the residential site. The detection limit for the instrument was 0.02 ppbv. Other compounds detected included acetic acid, methyl ethyl ketone, and hexane.

The results of the portable GC/MS sample analyses are summarized in Table 4-5. All four BTEX compounds were detected at the railcar hatch and storage tank vent in the parts per million by volume (ppmv) range. At the other locations, only ethyl benzene was detected (0.04 ppmv at both locations). The detection limit for the instrument was 0.02 ppmv.

The results of the organic vapor analyzer sample analyses are summarized in Table 4-6. Organic vapors (unspeciated) were detected in all locations. Concentrations ranged from 1.2 ppmv to 600 ppmv (at the railcar hatch).

This document cannot be used to develop emission factors because no data were collected that can be used to relate the measured concentrations to emission rates. In addition, no activity levels, such as asphalt tank loading rate, were measured.

4.2.1.332 Reference 360. This reports documents the results of a study to determine emission rates and emission factors for the load-out of hot mix asphalt into trucks. Samples were collected using SUMMA canisters at five facilities across North Carolina. The samples were subsequently by NCDAQ by GC/MS. Data also were collected on ambient and sample temperatures, emission velocities, and meteorological conditions.

Four of the five plants were drum-mix plants; the other plant was a continuous feed plant. During sampling the asphalt consisted of 100 percent virgin material (i.e., the mixes did not include RAP) using type I-2 asphalt.

The sampling apparatus consisted of a stainless steel funnel and Teflon tubing connected to a SUMMA canister. A thermal anemometer also was attached to the end of the apparatus near the funnel. Samples were collected by placing the funnel end of the apparatus in the bed of the receiving truck. A one-minute sample was collected as the hot mix asphalt was loaded into the truck. At the same time, velocity measurements were taken using the anemometer.

Table 4-7 summarizes the results of the analysis. Five samples were collected at each of the five facilities. For 11 of the 30 samples, the benzene concentrations were below the detection limit of 0.1 ppbv. For the other samples, the concentrations generally ranged from 0.2 to 6.7 ppbv. Two samples were determined to be outliers; the concentrations of those samples were 509 and 67 ppbv.

The mean benzene concentration from all samples was reported as 2.47 ppbv and the mean velocity was reported as 0.51 meters per second (m/sec). (It should be noted that the individual velocity measurements were not reported in the document.) Assuming this mean velocity is uniform over the entire truck bed and using an average truck bed area, the average emission rate (which was reported as an "emission factor" in the document) was determined to be 4.4×10^{-5} grams per second (g/sec).

The data from this study cannot be used to develop emission factors because activity level data were not reported (i.e., data on asphalt loading rates). In addition, the assumption that velocities are uniform and constant across the truck bed throughout the loading process is not realistic. Velocities were measured for 1-minute periods at single points over truck beds that averaged 10.9 square meters. The velocities should largely be the result of the loaded asphalt displacing the air in the truck bed. Consequently, it is expected that velocities would vary spatially (depending on the location of the probe relative to the loading point and bed sides) and temporally (depending on the profile of the loaded asphalt as the truck is filled) during load-out. In addition, it is unrealistic to assume that emissions are steady-state during the load-out. For the data to be useable for AP-42, the test would have to have been conducted throughout each load-out.

4.2.1.333 Reference 361. This document presents the results of a laboratory study of emissions from asphalt pavement. The objective of the study was to characterize emissions from the paving process. However, the investigators found it impractical to sample while simulating the process of placing and compacting asphalt, and maintaining the temperature profiles characteristic of real paving operations. Instead, the study entailed measuring emissions from a static layer of compacted hot mix asphalt maintained at the highest temperature likely to be encountered in an actual paving operation. Initially, emissions were sampled from a layer of asphalt that was 3.8 centimeters (cm) (1.5 inches [in.]) thick. Subsequently, a 1.3 to 1.9 cm (0.5 to 0.75 in.) layer was used to ensure a more uniform temperature distribution throughout the asphalt.

Emissions from two types of hot mix asphalt were sampled. One sample contained no rubber; in the other sample, 18 percent of the nonaggregate materials consisted of crumb rubber. Both samples contained approximately 24 percent RAP. The heating vessel measured 2 feet by 2 feet (60 centimeters by 60 centimeters). The emission stream was sampled for 65 semivolatile organics by Method TO-13 using a PM-10 sampler to collect the samples, which were subsequently analyzed by Method 8270. The PM-10/semivolatile sampling train was operated for a period of 130 to 165 minutes. For VOCs, the exhaust stream was sampled by Method 18 (grab samples collected in Tedlar bags) and analyzed by Method TO-14 for 56 compounds. A separate PM-10 sampler was used to quantify emissions of PM-10 and metals; the catch was analyzed for metals by graphite furnace atomic adsorption (GFAA). Semiquantitative analysis of samples for hydrogen sulfide was performed using colorimetric Draeger tubes. In addition, continuous emission monitoring systems (CEMS) were operated to measure concentrations of carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxide (NO), oxygen, sulfur dioxide (SO_2), total hydrocarbons (TOC), and polycyclic aromatic hydrocarbons (PAHs).

Table 4-8 summarizes the results of the tests for VOCs semivolatiles, PM, and metals. Most of the target compounds were not detected in the samples, and, among those that were detected, most concentrations were near the detection limit. Altogether, 12 organic compounds were found in concentrations that were significantly higher than the blank sample concentrations. In addition, emissions of lead, PM-10, and total PM were quantified. Table 4-9 summarizes the CEMS data. With the exception of the PAH monitor, the facility blank emission levels measured were comparable to the emission levels measured during the test. Therefore, the CEMS results are of limited use. In addition, the VOC emission rates are based on grab samples. The report does not specify when samples were collected. In an actual paving operation, emissions would be expected to peak when the pavement is placed and decline as the pavement cooled. Data based on grab samples might be representative if samples were taken over an extended period of time. On the other hand, the data on semivolatile compound and PM emissions are likely to be more representative of pavement emissions because they are based on samples collected over periods of 2 to 2.5 hours.

The semivolatile and PM data may be useful in making gross estimates of emissions from the laying of asphalt pavement. However, it is questionable how representative the data are. Heating the test samples to relatively high temperatures for several hours is likely to have biased the emission data; emissions from actual pavement would be expected to decline from the time it is placed as a result of the decline of the pavement temperature. Additionally, the emissions of PAH compounds with higher vapor pressures (e.g., naphthalene) are lower than the PAH compounds with lower vapor pressures. This contrasts with the data from References 339 and 340, where PAH compounds with higher vapor pressures had higher emissions. The data should not be used to estimate emissions from paving operations because the test did not cover the initial period when the asphalt was placed and compacted, and the temperature was maintained at 325°F for an extended time.

4.2.1.334 Reference 362. This document presents the results of emission tests conducted at two batch mix plants. The data from these tests were used to prepare Reference 17, described previously in this section. Uncontrolled emissions were sampled from either the skip hoist or hopper that followed the batch mixer. In both tests, the skip hoist/hopper were open top vessels and had to be shrouded to minimize wind effects on emissions. Emissions were sampled for a variety of organic and inorganic pollutants. Particulate matter emissions were sampled using high volume samplers; the other pollutants were sampled using evacuated canisters or cylinders. A variety of nonreference methods were used to determine pollutant concentrations. However, exhaust gas flow rates were not measured. Therefore, the data cannot be used to develop emission factors.

4.2.1.335 Reference 363. This document presents the results of a laboratory study of emissions from asphalt roofing. A sample of roofing asphalt was heated in a kettle at various temperatures. Emissions from the kettle were sampled for speciated VOC using a modified volatile organic sampling train (VOST) and for speciated semivolatile compounds using XAD-2 and Pallflex filters. The samples were analyzed by GC/MS. Emissions were quantified for a variety of volatile and semivolatile compounds. Emission concentration were reported, as well as emission rates in units of milligrams emitted per square meter of surface area per hour. Emission factors were calculated in units of milligrams emitted per kilogram of asphalt heated. However, the data represent emissions from roofing asphalt heating and do not pertain to hot mix asphalt production. Therefore, the data are not presented here.

4.2.1.336 Reference 364. This report documents an emission test conducted at the inlet and outlet of a “Smog Hog” electrostatic precipitator (ESP) that controls emissions from HMA truck load-out. According to industry representatives the facility was typical of the industry relative to mix temperature, mix constituents, production rate, and other operating parameters. Filterable PM, condensable inorganic PM, condensable organic PM, and TOC emissions were measured using CARB Method 5 (front- and back-half analysis) and EPA Method 25A, respectively.

The capture efficiency of the control system was not measured during the test. However, in an evaluation of the test report by an EPA contractor, an assessment of the capture efficiency was made. The assessment was made based upon the available information on the load-out area in this test report. The assessment indicates that an average face velocity of building air of about 42 feet per minute was estimated from data in the report. It was recognized that this velocity is outside the recommended range of 50 to 100 feet per minute specified in the Industrial Ventilation Manual. It also was recognized that the enclosure did not meet all of the criteria for a permanent total enclosure (PTE) specified in the EPA document, “The Measurement Solution: Using a Temporary Total Enclosure for Capture Efficiency Testing.” Finally, the assessment provided an estimated range of capture efficiency of between 70 and 90 percent. While this capture efficiency assessment could be reevaluated using the measured capture efficiency and emissions documented in Reference 355, this is unnecessary since this test was not used for developing the final emission factor.

The emission data are assigned a rating of C because the test was not fully documented and incomplete process information was provided in the report. However, the data were not used to develop emission factors for inclusion in AP-42 because: (1) the emissions measured included the combined silo and load-out emissions; (2) some data on process rates was missing from the report; (3) data on asphalt characteristics (temperature and volatility) were not included in the report; (4) the capture efficiency of the enclosure was not measured during the test; and, most importantly, (5) emissions test data for the loadout process were available from two other tests, including a test at this same facility, that included complete process information and documentation.

4.2.1.337 References 365 to 369. These documents consist of a series of personal communications by email regarding Department of Transportation loss-on-heating values for several State agencies. No emission data were included, but the data were used to develop a default loss-on-heating value.

4.2.1.338 Reference 370. This reference documents an emission test conducted on a batch mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 15 percent RAP during the emission test. The test included measurements CO and CO_2 at the fabric-filter outlet. Carbon monoxide emissions were quantified using EPA Method 10, and CO_2 concentrations were measured by Orsat. Three test runs were conducted.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.339 Reference 371. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 24 percent RAP during the emission test. The sulfur content of the fuel was 0.46 percent. The test included measurements of filterable PM, SO_2, CO_2, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.340 Reference 372. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 25 percent RAP during the emission test. The sulfur content of the fuel was 0.37 percent. The test included measurements of filterable PM, SO_2, CO_2, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.341 Reference 373. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 25 percent RAP during the emission test. The sulfur content of the fuel was 0.63 percent. The test included measurements of filterable PM, SO_2, CO_2, benzene, chlorobenzene, dichlorobenzene, trichlorobenzene, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; EPA Method 0011 was used to quantify formaldehyde emissions; and Method 18 was used to quantify benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit for each run.

The filterable PM, CO_2, and formaldehyde test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The SO_2 and benzene data are rated B because the report did not include complete documentation on those pollutants. The chlorobenzene, dichlorobenzene, and trichlorobenzene data were not rated.

4.2.1.342 Reference 374. This reference documents an emission test conducted on a portable parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The report did not specify if the facility was processing RAP during the emission test. However, the report did include information on fuel usage and fuel sulfur content. The sulfur content of the fuel was 0.44 percent. The test included measurements of filterable PM, SO_2, CO_2, and HCl at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 26 was used to quantify HCl emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.343 Reference 375. This reference documents an emission test conducted on a portable, parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 20 percent RAP during the emission test. The sulfur content of the fuel was 0.39 percent. The test included measurements of filterable PM, SO_2, CO_2, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.344 Reference 376. This reference documents an emission test conducted on a portable, parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was not processing RAP during the emission test. The sulfur content of the fuel was 0.43 percent. The test included measurements of filterable PM, SO_2, CO_2, benzene, and HCl at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; EPA Method 18 was used to measure benzene emissions; and EPA Method 26 was used to quantify HCl emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.345 Reference 377. This reference documents an emission test conducted on a continuous, parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 20 percent RAP during the emission test. The sulfur content of the fuel was 0.47 percent. The test included measurements of filterable PM, SO_2, CO_2, benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and Method 18 was used to quantify benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit for each run.

The filterable PM, SO_2, CO_2, and benzene test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The chlorobenzene, dichlorobenzene, and trichlorobenzene data were not rated.

4.2.1.346 Reference 378. This reference documents an emission test conducted on a batch mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 15 percent RAP during the emission test. The test included measurements CO and CO_2 at the fabric-filter outlet. Carbon monoxide emissions were quantified using EPA Method 10, and CO_2 concentrations were measured by Orsat Three test runs were conducted.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.347 Reference 379. This reference documents an emission test conducted on a portable, counter-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was processing about 15 percent RAP during the emission test. The sulfur content of the fuel was 0.43 percent. The test included measurements of SO_2, CO_2, and HCl at the fabric-filter outlet. Sulfur dioxide emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 26 was used to quantify HCl emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.348 Reference 380. This reference documents an emission test conducted on a portable, parallel-flow, rotary drum-mix dryer fired with drain oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was not processing RAP during the emission test. The sulfur content of the fuel was 0.66 percent. The test included measurements of filterable PM, SO_2, CO_2, and HCl at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; SO_2 emissions were sampled using EPA Method 6; CO_2 concentrations were measured by Orsat; and EPA Method 26 was used to quantify HCl emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.349 Reference 381. This reference documents an emission test conducted on a batch mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 15 percent RAP during the emission test. The test included measurements CO and CO_2 at the fabric-filter outlet. Carbon monoxide emissions were quantified using EPA Method 10, and CO_2 concentrations were measured by Orsat Three test runs were conducted.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.350 Reference 382. This reference documents an emission test conducted on a batch mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 percent RAP during the emission test. The test included measurements filterable PM, CO_2, benzene, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; EPA Method 0011 was used to quantify formaldehyde emissions; and Method 18 was used to quantify benzene emissions. Three test runs were conducted.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.351 Reference 383. This reference documents an emission test conducted on a rotary drum-mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 15 percent RAP during the emission test. The test included measurements of filterable PM, CO_2, formaldehyde, benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; formaldehyde emissions were quantified using EPA Method 0011; and Method 18 was used to quantify benzene, chlorobenzene, dichlorobenzene, and trichlorobenzene emissions. Three test runs were conducted for each pollutant. The concentrations of chlorobenzene, dichlorobenzene, and trichlorobenzene were below the detection limit for each run.

The filterable PM, CO_2, formaldehyde, and benzene test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported. The chlorobenzene, dichlorobenzene, and trichlorobenzene data were not rated.

4.2.1.352 Reference 384. This reference documents an emission test conducted on a continuous, counter-flow, rotary drum-mix dryer fired with natural gas. Emissions from the dryer are controlled by a fabric filter. The facility was processing about 20 to 25 percent RAP during the emission test. The test included measurements of filterable PM, CO_2, formaldehyde, and benzene at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 17; CO_2 concentrations were measured by Orsat; formaldehyde emissions were quantified using EPA Method 0011; and Method 18 was used to quantify benzene emissions. Three test runs were conducted for each pollutant.

The filterable PM, CO_2, formaldehyde, and benzene test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.353 Reference 385. This reference documents an emission test conducted on a batch mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The report did not specify if the facility was processing RAP during the emission test. However, the report did include information on fuel usage and fuel sulfur content. The sulfur content of the fuel was 0.36 percent. The test included measurements of filterable, condensable inorganic PM, condensable organic PM, SO_2, and CO_2 at the fabric-filter outlet. Filterable PM emissions were measured using EPA Method 5; condensable PM emissions were quantified by EPA Method 202; SO_2 emissions were quantified using EPA Method 6C; and CO_2 concentrations were measured by Orsat. Three test runs were conducted.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.354 Reference 386. This reference documents two emission tests conducted on a continuous, parallel-flow, rotary drum-mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was not processing RAP during the emission tests. The sulfur content of the fuel was 0.50 percent. The initial test included measurements of SO_2 and CO_2 at the fabric-filter outlet. In the second test, emissions of filterable PM and CO_2 were measured. Filterable PM emissions were quantified using EPA Method 5; SO_2 emissions were sampled using EPA Method 6C; and CO_2 concentrations were measured by Orsat. Three test runs were conducted for each pollutant during each test.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.355 Reference 387. This reference documents two emission tests conducted on a continuous, parallel-flow, rotary drum-mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was not processing RAP during the emission tests. The sulfur content of the fuel was 0.47 percent. One test included measurements of SO_2 and CO_2 at the fabric-filter outlet. In the other test, emissions of filterable PM and CO_2 were measured. Filterable PM emissions were quantified using EPA Method 5; SO_2 emissions were sampled using EPA Method 6C; and CO_2 concentrations were measured by Orsat. Three test runs were conducted for each pollutant during each test.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.356 Reference 388. This reference documents an emission test conducted on a continuous, parallel-flow, rotary drum-mix dryer fired with waste oil. Emissions from the dryer are controlled by a fabric filter. The test report included information on RAP usage, fuel usage, and fuel sulfur content. The facility was not processing RAP during the emission tests. The sulfur content of the fuel was 0.36 percent. The test included measurements of filterable PM, condensable inorganic PM, condensable organic PM, SO_2, CO_2, and formaldehyde at the fabric-filter outlet. Filterable PM emissions were quantified using EPA Method 5; condensable PM emissions were quantified using Method 202; SO_2 emissions were sampled using EPA Method 6C; CO_2 concentrations were measured by Orsat; and EPA Method 0011 was used to quantify formaldehyde emissions. Three test runs were conducted for each pollutant.

The test data are assigned an A rating. The report contained adequate detail, the test methodology was sound, and no problems were reported.

4.2.1.357 Reference 395. This report includes four separate emission tests that were conducted for NAPA at four hot mix asphalt plants. Each test included three 72-minute test runs that measured formaldehyde and carbon monoxide emissions from hot oil systems (HOS), which are the systems that heat the hot asphalt oil that is used in the production of HMA. Formaldehyde emissions were measured using EPA Method 316, CO emissions were measured using EPA Method 10, and CO_2 emissions were measured using EPA Method 3 (Fyrite analyzer) . The HOS burners were operated at high-fire, constant load conditions during testing, and heat sinks were used to prevent the burners from shutting down during testing. The facilities tested were: (1) S.T. Wooten, Franklinton, NC; (2) S.T. Wooten, Clayton, NC; (3) REA Construction, Mallard Creek, NC; and (4) REA Construction, North Mecklenburg, NC. The following paragraphs discuss unique aspects of each of the individual emission tests.

Testing at S.T. Wooten, Franklinton, NC, was conducted on March 25, 2003. The HOS was fired with No. 2 fuel oil at a rate of 3.0 gallons per hour (gph) during all three test runs. Using the average No. 2 fuel oil heating value documented in AP-42 Section 1.3 (140 million British thermal units [MMBtu] per 1,000 gallons]), this fuel usage rate is equivalent to 0.42 MMBtu/hr. One problem that was reported during the testing was that the Run 1 pre-test flow rate was 12.6 percent greater than the post-test flow rate. This may have introduced a positive bias of up to 12.6 percent on the formaldehyde and CO emissions reported for Run 1. No other problems were reported. The data from this test are assigned a B rating because of the problem documented during Run 1.

Testing at S.T. Wooten, Clayton, NC, was conducted on March 27, 2003. The HOS was fired with No. 2 fuel oil at a rate of 6.5 gph during all three test runs. Using the average No. 2 fuel oil heating value documented in AP-42 Section 1.3 (140 MMBtu per 1,000 gallons]), this fuel usage rate is equivalent to 0.91 MMBtu/hr. Formaldehyde was not detected during Runs 2 and 3, and the detection limits for the two runs were 1.55 parts per billion by volume, dry basis (ppbv), and 1.39 ppbv, respectively. No problems were reported. The formaldehyde data from this test are assigned a B rating because two of the three test runs did not detect formaldehyde, and for purposes of emission factor development, emissions from these two runs were estimated as one-half of the detection limit. The carbon monoxide data from this test are assigned an A rating. The CO_2 data from this test are assigned a B rating because of the relative inaccuracy of Fyrite analyzers (compared to Orsat analyzers).

Testing at REA Construction, Mallard Creek, NC, was conducted on April 1, 2003. The HOS was fired with natural gas at a rate of 1,700 cubic feet per hour (cfh) during all three test runs. Using the average natural gas heating value documented in AP-42 Section 1.4 (1,020 Btu per standard cubic foot [scf]), this fuel usage rate is equivalent to 1.73 MMBtu/hr. In the test report, the maximum natural gas heating value (from AP-42 Section 1.4) of 1,050 Btu/scf was used as a conversion factor, but for purposes of developing emission factors for AP-42, the average value of 1,020 Btu/scf was used. Carbon monoxide was not detected during any test run at a detection limit of 0.2 parts per million by volume, dry basis (ppmv). No problems were reported. The formaldehyde data from this test are assigned an A rating. The CO data from this test are assigned a B rating because CO was not detected during any test run, and for purposes of emission factor development, a value equal to one-half of the detection limit was used to estimate CO emissions. The CO_2 data from this test are assigned a B rating because of the relative inaccuracy of Fyrite analyzers (compared to Orsat analyzers).

Testing at the REA Construction North Mecklenburg facility was conducted on April 2 and 3, 2003. The HOS was fired with No. 2 fuel oil at a rate of 7.0 gph during all three test runs. Using the average No. 2 fuel oil heating value documented in AP-42 Section 1.3 (140 MMBtu per 1,000 gallons]), this fuel usage rate is equivalent to 0.98 MMBtu/hr. No problems were reported. The formaldehyde and CO data from this test are assigned an A rating. The CO_2 data from this test are assigned a B rating because of the relative inaccuracy of Fyrite analyzers (compared to Orsat analyzers).

4.2.2 Review of FIRE and SPECIATE Data Base Emission Factors

Emission factors for hot mix asphalt plants appear in both FIRE and SPECIATE. Many of the factors in FIRE are the factors currently presented in AP-42, but some additional data also are included in FIRE. Most of the additional data are labeled “confidential,” and the references are not available for review. The other data in FIRE do not appear to be useful for developing emission factors for the revised AP-42 section. The references for the factors in SPECIATE were not obtained. The validity of the references could not be checked, so the information was not used in developing emission factors for the revised AP-42 section.

4.2.3 Review of the AP-42 Background File

The AP-42 section addressing the hot mix asphalt industry was last published in July 1994. Forty-three references are cited in the existing section, and descriptions of these references are included in Section

4.2.4 Results of Data Analysis

This section discusses the analysis of the data and describes how the data were combined to develop average emission factors for HMA production. Target pollutants that were not detected during any of the tests reviewed are shown in Table 4-10. Test data for drum-mix dryers are presented in Table 4-11, data for batch-mix dryers are shown in Table 4-12, and data for hot oil heaters are shown in Table 4-13. Section 4.3 describes the statistical analysis that was conducted for the large data sets. The analysis presents the rational for aggregating and segregating data for emission factor development for the large data sets. Section 4.4 presents an analysis of available data for HMA load-out operations, storage-silo filling, truck emissions, and storage-tank emissions.

The emission factor ratings assigned to each of the candidate emission factors developed for HMA production are based on the emission data ratings and the number of tests conducted.

4.2.4.1 Drum-Mix Dryers. Emission factors for drum-mix dryers were developed using the data presented in Table 4-11. The candidate emission factors for drum-mix dryers are shown in Tables 4-14, 4-15, 4-16, and 4-17.

4.2.4.1.1 Filterable PM. An emission factor for uncontrolled filterable PM emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from four A-rated and two B-rated tests. The data range from 1.3 to 37 kg/Mg (2.6 to 73 lb/ton) and average 14 kg/Mg (28 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for filterable PM emissions from fabric filter-controlled drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 155 tests. The data range from 0.00044 to 0.071 kg/Mg (0.00089 to 0.14 lb/ton) and average 0.0067 kg/Mg (0.014 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.0087 kg/Mg (0.017 lb/ton) and the median is 0.0050 kg/Mg (0.010 lb/ton).

An emission factor for filterable PM emissions from venturi scrubber-controlled drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 36 tests. The data range from 0.0018 to 0.049 kg/Mg (0.0036 to 0.097 lb/ton) and average 0.013 kg/Mg (0.026 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.011 kg/Mg (0.022 lb/ton) and the median is 0.010 lb/ton (0.020 lb/ton).

4.2.4.1.2 Size-Specific PM. For uncontrolled drum-mix dryers, no new particle size data are available. The particle size data from Reference 23 (the background document for the 1986 revision of the hot mix asphalt AP-42 section) were retained. To determine size specific emission factors, the percentages of PM-15, PM-10, and PM-2.5 were multiplied by the emission factor for filterable PM from uncontrolled drum-mix dryers. The emission factor for PM-15 is 27 percent of 14 kg/Mg (28 lb/ton), or 3.8 kg/Mg (7.6 lb/ton). The emission factor for PM-10 is 23 percent of 14 kg/Mg (28 lb/ton), or 3.2 kg/Mg (6.4 lb/ton). The emission factor for PM-2.5 is 5.5 percent of 14 kg/Mg (28 lb/ton), or 0.77 kg/Mg (1.5 lb/ton). These emission factors are assigned E ratings because the particle size data are based on a single test.

For PM-15 emissions from fabric filter-controlled drum-mix dryers, the particle size data from Reference 23 were used to estimate the PM-15 percentage of filterable PM. The percentage of PM-15 is 35 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled drum-mix dryers. The candidate emission factor for PM-15 is 35 percent of 0.0064 kg/Mg (0.013 lb/ton), or 0.0022 kg/Mg (0.0046 lb/ton). This emission factor is assigned an E rating because the particle size data are based on a single test.

For PM-10 emissions from fabric filter-controlled drum-mix dryers, the particle size data from Reference 23 were used in conjunction with data from two additional tests. The average percentage of PM-10 from the three tests is 30 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled drum-mix dryers. The candidate emission factor for PM-10 is 30 percent of 0.0064 kg/Mg (0.013 lb/ton), or 0.0019 kg/Mg (0.0039 lb/ton). This emission factor is assigned a D rating because the particle size data are based on three tests.

For PM-2.5 emissions from fabric filter-controlled drum-mix dryers, the particle size data from Reference 23 were used in conjunction with data from two additional tests. The average percentage of PM-2.5 from the three tests is 21 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled drum-mix dryers. The candidate emission factor for PM-2.5 is 21 percent of 0.0064 kg/Mg (0.013 lb/ton), or 0.0013 kg/Mg (0.0027 lb/ton). This emission factor is assigned a E rating because the particle size data are based on three tests that show a wide range of PM-2.5 percentages.

For PM-1 emissions from fabric filter-controlled drum-mix dryers, data from two tests were used to estimate the PM-1 percentage of filterable PM. The average percentage of PM-1 from the two tests is 15 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled drum-mix dryers. The candidate emission factor for PM-1 is 15 percent of 0.0064 kg/Mg (0.013 lb/ton), or 0.00096 kg/Mg (0.0019 lb/ton). This emission factor is assigned a E rating because the particle size data are based on two tests that show a wide range of PM-1 percentages.

4.2.4.1.3 Condensable organic PM. An emission factor for uncontrolled condensable organic PM emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from three A-rated tests. The data range from 0.021 to 0.042 kg/Mg (0.041 to 0.083 lb/ton) and average 0.029 kg/Mg (0.058 lb/ton). This candidate emission factor is assigned an E rating.

An emission factor for fabric filter- or venturi scrubber-controlled condensable organic PM emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 41 tests. The data range from 0.00018 to 0.037 kg/Mg (0.00035 to 0.074 lb/ton) and average 0.0059 kg/Mg (0.012 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.0081 kg/Mg (0.016 lb/ton) and the median is 0.0023 kg/Mg (0.0046 lb/ton).

4.2.4.1.4 Condensable inorganic PM. An emission factor for fabric filter- or venturi scrubber-controlled condensable inorganic PM emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 30 tests. The data range from 0.00059 to 0.014 kg/Mg (0.0012 to 0.027 lb/ton) and average 0.0037 kg/Mg (0.0074 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.0032 kg/Mg (0.0063 lb/ton) and the median is 0.0025 lb/ton (0.0051 lb/ton).

4.2.4.1.5 Total condensable PM. Emission factors for total condensable PM emissions from fabric filter-controlled drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) were developed from three A-rated tests. The data range from 0.00048 to 0.010 kg/Mg (0.00096 to 0.019 lb/ton) and average 0.0041 kg/Mg (0.0082 lb/ton). This emission factor is not rated because much larger data sets are available for condensable organic and inorganic PM. Total condensable PM is calculated as the sum of the condensable organic and inorganic PM emission factors, which is 0.010 kg/Mg (0.021 lb/ton).

4.2.4.1.6 Total PM and PM-10. The total PM emission factors shown in the AP-42 table represent the sum of the filterable PM, condensable organic PM, and condensable inorganic PM emission factors. These emission factors are rated the same as the lowest rated emission factor used in the summation. The total PM-10 emission factors shown in the AP-42 table represents the sum of the filterable PM-10, condensable organic PM, and condensable inorganic PM emission factors. These emission factors are rated the same as the lowest rated emission factor used in the summation.

An emission factor for cyclone- or multiclone-controlled drum-mix dryers was developed using data from a single test. The emission factor is 0.34 kg/Mg (0.67 lb/ton). This candidate emission factor is assigned an E rating.

4.2.4.1.7 Carbon monoxide. An emission factor for uncontrolled CO emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 18 tests. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce CO emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce CO emissions. Data from one additional test were excluded from the candidate emission factor because the magnitude of emissions from the test are an order of magnitude higher than the next highest data point and more than two orders of magnitude higher than the lowest data point. The data range from 0.0055 to 0.30 kg/Mg (0.011 to 0.60 lb/ton) and average 0.063 kg/Mg (0.13 lb/ton). This candidate emission factor is assigned a C rating.

4.2.4.1.8 Carbon dioxide. An emission factor for uncontrolled CO_2 emissions from drum-mix dryers (fired with natural gas, propane, butane, coal, fuel oil, or waste oil) was developed using data from tests conducted on 180 dryers. The tests were conducted on fabric filter- or venturi scrubber-controlled dryers, but these control devices are not expected to reduce CO_2 emissions. The data range from 1.3 to 48 kg/Mg (2.6 to 96 lb/ton) and average 17 kg/Mg (33 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 6.4 kg/Mg (13 lb/ton) and the median is 16 kg/Mg (31 lb/ton).

4.2.4.1.9 Nitrogen oxides. An emission factor for uncontrolled NO_x emissions from natural gas- or propane-fired drum-mix dryers was developed using data from five A-rated tests and one B-rated test. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce NO_x emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce NO_x emissions. The data range from 0.0075 to 0.025 kg/Mg (0.015 to 0.049 lb/ton) and average 0.013 kg/Mg (0.026 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for uncontrolled NO_x emissions from fuel oil- or waste oil-fired drum-mix dryers was developed using data from 10 A-rated tests and one B-rated test. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce NO_x emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce NO_x emissions. The data range from 0.0085 to 0.055 kg/Mg (0.017 to 0.11 lb/ton) and average 0.028 kg/Mg (0.055 lb/ton). This candidate emission factor is assigned a C rating.

4.2.4.1.10 Sulfur dioxide. Limited data were available for venturi scrubber-controlled drum mix dryers. Therefore, data for fabric filter and venturi scrubber controlled dryers were combined. Venturi scrubbers are expected to perform at least as well as fabric filters in controlling SO_2 emissions.

An emission factor for controlled SO_2 emissions from natural gas- or propane-fired drum-mix dryers was developed using data from three A-rated tests. The tests were conducted on fabric filter-controlled dryers. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers. The data range from 0.00062 to 0.0024 kg/Mg (0.0012 to 0.0048 lb/ton) and average 0.0017 kg/Mg (0.0034 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for controlled SO_2 emissions from No. 2 fuel oil-fired drum-mix dryers was developed using data from three A-rated tests and one C-rated test. The tests were conducted on fabric filter- or venturi scrubber-controlled dryers, which showed similar emissions. The data range from 0.00048 to 0.013 kg/Mg (0.00095 to 0.026 lb/ton) and average 0.0054 kg/Mg (0.011 lb/ton). This candidate emission factor is assigned an E rating because the limited data range over more than an order of magnitude.

An emission factor for controlled SO_2 emissions from No. 6 fuel oil- or waste oil-fired drum-mix dryers was developed using data from 16 A-rated tests and 2 B-rated test. The tests were conducted on fabric filter-controlled dryers. This factor also can be used to estimate emissions from venturi scrubber-controlled dryers. The data range from 0.0041 to 0.081 kg/Mg (0.0081 to 0.16 lb/ton) and average 0.029 kg/Mg (0.058 lb/ton). This candidate emission factor is assigned a B rating.

Table 4-15 shows all of the available data for SO_2 emissions from drum mix dryers. Process characteristics, including fuel type, plant type (counter-flow or parallel-flow), fuel sulfur content, and amount of RAP used, were also available in the test reports. Reference 391 presents an examination of these characteristics that was performed to determine their effect on SO_2 emissions. The analysis of the SO_2 data shows that both fuel type and the air pollution control device had significant effects on SO_2 emissions. Table 2 of Reference 391 presents the SO_2 data, and includes the percentage of fuel-bound sulfur emitted as SO_2 during each emission test (where available) and the potential SO_2 emissions (in lb/ton of HMA produced) that was not emitted. The analysis suggests that if a mass balance technique is used to estimate SO_2 emissions from drum mix dryers, it is appropriate to assume that only a percentage of the fuel-bound sulfur is emitted as SO_2. The data indicate that between 3 percent and 53 percent of fuel bound sulfur is emitted as SO_2, and the SO_2 mass balance analysis includes an assumption that all of the SO_2 emissions emanate from the fuel (and not from the aggregate or asphalt). The data also show a maximum reduction (from the potential SO2 emissions) of 0.055 kg/Mg (0.11 lb/ton) of SO_2. The exact reason that all of the sulfur is not emitted as SO_2 is not known, although possible reasons include the use of limestone, which could react with SO_2, as a feed material at some HMA facilities. The following statement was added to the footnote for SO_2: "Fifty percent of the fuel-bound sulfur, up to a maximum (as SO_2) of 0.1 lb/ton of product, is expected to be retained in the product, with the remainder emitted as SO_2." Fifty percent is the highest percentage of fuel-bound sulfur emitted as SO_2 (rounded to the nearest 10 percent) shown by the available data, which average 38 percent sulfur emitted as SO_2. The 0.05 kg/Mg (0.1 lb/ton) maximum is recommended so that facilities with fuel sulfur loadings higher than those represented in the available data set will not underestimate SO_2 emissions.

One additional parameter included in Table 2 of Reference 391 is the plant type (counter-flow or parallel-flow). Upon inspection, the data show little correlation between plant type and SO_2 emissions. This analysis is based on the data set for drain oil/waste oil/No. 6 fuel oil-fired dryers, because the data sets for the other fuels are too small to draw any meaningful conclusions. The SO_2 emissions from parallel-flow and counter-flow plants average 0.053 lb/ton and 0.048 lb/ton, respectively. The percent of fuel-bound sulfur emitted as SO_2 from parallel-flow and counter-flow plants averages 41 percent and

30 percent, respectively. Because of the small difference in the average emission factors and percent sulfur emitted from parallel-flow and counter-flow plants, separate emission factors are not recommended based on plant type.

An emission factor for controlled SO_2 emissions from coal-fired drum-mix dryers (also using supplementary gas or oil) was developed using data from three A-rated tests and one B-rated test. The tests were conducted on fabric filter- and venturi scrubber-controlled dryers, which showed similar emissions. Data from the No. 6 fuel oil-fired HMA plants indicate a minimum of 50 percent retention of sulfur (as SO_2) in the product. However, no data are available to indicate similar retention at higher concentrations of SO_2 as may occur from coal-fired plants. The data range from 0.0012 to 0.38 kg/Mg (0.0024 to 0.75 lb/ton) and average 0.097 kg/Mg (0.19 lb/ton). This candidate emission factor is assigned an E rating because the data range over two orders of magnitude.

The SO_2 data from Reference 350 were not used in the development of emission factors. The drum mix dryer tested was fired with a combination of drain oil and natural gas. Because of this unusual combination of fuels and the lack of information on the relative amounts of the two fuels, it was not possible to include the data in the emission factor calculations for oil-fired or natural gas-fired dryers, and a separate emission factor for this fuel combination did not appear to be warranted.

4.2.4.1.11 Total organic compounds. An emission factor for uncontrolled TOC (as propane) emissions from natural gas-, fuel oil-, or waste oil-fired drum-mix dryers was developed using data from twelve A-rated tests, four B-rated tests, and one C-rated test. The data range from 0.0029 to 0.059 kg/Mg (0.0058 to 0.12 lb/ton) and average 0.021 kg/Mg (0.041 lb/ton). This candidate emission factor is assigned a B rating. Because the test method for TOC (Method 25A) does not measure formaldehyde emissions, actual TOC emissions can be estimated by adding the formaldehyde emission factor for drum-mix dryers (0.0013 kg/Mg [0.0025 lb/ton]) to the candidate TOC factor.

4.2.4.1.12 Methane, benzene, ethylbenzene, toluene, and xylene. An emission factor for uncontrolled methane emissions from natural gas-, fuel oil-, or waste oil-fired drum-mix dryers was developed using data from five A-rated tests, two B-rated tests, and one C-rated test. The data range from 6.8×10^{-5} to 0.019 kg/Mg (0.00014 to 0.038 lb/ton) and average 0.0058 kg/Mg (0.012 lb/ton). This candidate emission factor is assigned a C rating.

An emission factor for uncontrolled benzene emissions from natural gas-, fuel oil-, or waste oil-fired drum-mix dryers was developed using data from 15 A-rated tests, three B-rated tests, and one C-rated test. The data range from 3.2×10^{-5} to 0.00060 kg/Mg (6.3×10^{-5} to 0.0012 lb/ton) and average 0.00020 kg/Mg (0.00039 lb/ton). The median for the data is 0.00015 kg/Mg (0.00030 lb/ton), and the standard deviation is 0.00016 kg/Mg (0.00031 lb/ton). This candidate emission factor is assigned an A rating. Data from one additional C-rated test (Reference 48) are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

An emission factor for uncontrolled ethylbenzene emissions from natural gas-, fuel oil-, or waste oil-fired drum-mix dryers was developed using data from two B-rated tests and one C-rated test. The data range from 2.6×10^{-5} to 0.00019 kg/Mg (5.1×10^{-5} to 0.00038 lb/ton) and average 0.00012 kg/Mg (0.00024 lb/ton). This candidate emission factor is assigned a D rating. Data from two additional C-rated tests (References 48 and 50) are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

An emission factor for uncontrolled toluene emissions from natural gas- or propane-fired drum-mix dryers was developed using data from one A-rated, one B-rated, and one C-rated test. The data range from 2.3 x 10^{-5} to 0.00011 kg/Mg (4.5 x 10^{-5} to 0.00022 lb/ton) and average 7.3 x 10^{-5} kg/Mg (0.00015 lb/ton). This candidate emission factor is assigned a D rating. Data from one additional C-rated test (Reference 48) are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

An emission factor for uncontrolled toluene emissions from fuel oil- or waste oil-fired drum-mix dryers was developed using data from three B-rated tests and one C-rated test. The data range from 0.00015 to 0.0037 kg/Mg (0.00029 to 0.0074 lb/ton) and average 0.00037 kg/Mg (0.00075 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for uncontrolled xylene emissions from natural gas-, fuel oil-, or waste oil-fired drum-mix dryers was developed using data from one A-rated test, one B-rated test, and one C-rated test. The data range from 2.6 x 10^{-5} to 0.00020 kg/Mg (5.1 x 10^{-5} to 0.00040 lb/ton) and average 0.00010 kg/Mg (0.00020 lb/ton). This candidate emission factor is assigned a D rating. Data from two additional C-rated tests are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

4.2.4.1.13 Polynuclear aromatic hydrocarbons. Emission factors were developed for several PAHs, including 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, cumene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, and pyrene emissions from fabric filter-controlled drum-mix dryers fired by various fuels. Emission factors from dryers fired by natural gas and propane were combined, and emission factors for dryers fired by different types of oil were combined. However, if the data indicated that emissions from waste oil- or No. 6 fuel oil-fired dryers were significantly higher than emissions from other fuel oil, separate factors were presented for these fuels. The emission factors that are based on only one or two tests are assigned E ratings, and the factors based on three or more tests are assigned D ratings. Table 4-17 shows the data combination for PAHs and other organic compounds.

4.2.4.1.14 Formaldehyde. An emission factor for uncontrolled formaldehyde emissions from drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 19 A-rated tests and 2 B-rated tests. The data range from 0.00015 to 0.0070 kg/Mg (0.00030 to 0.014 lb/ton) and average 0.0016 kg/Mg (0.0031 lb/ton). For this data set, the standard deviation is 0.0018 kg/Mg (0.0036 lb/ton) and the median is 0.0010 kg/Mg (0.0020 lb/ton). This candidate emission factor is assigned a A rating. Additional data from 16 D-rated tests were not used to develop this candidate emission factor.

4.2.4.1.15 Aldehydes and ketones. With the exception of formaldehyde, emission factors for all aldehydes and ketones were developed using data from a single test. Uncontrolled emission factors were developed for acetaldehyde, acetone, acrolein, benzaldehyde, butyraldehyde/isobutyraldehyde, crotonaldehyde, hexanal, isovaleraldehyde, methyl ethyl ketone, propionaldehyde, quinone, and valeraldehyde emissions from waste oil-fired drum-mix dryers. These emission factors are assigned E ratings.

4.2.4.1.16 Trace metals. Emission factors were developed for metals emissions from fabric filter- and venturi scrubber-controlled drum-mix dryers (fired with natural gas, propane, fuel oil, or waste oil). The emission factors and data combination are presented in Table 4-16. The data for different fuel types generally were combined because there were significant overlaps in the range of test-specific emission factors for different fuels. The two exceptions to this procedure were lead and mercury. For these two metals, the magnitude of emissions from natural gas-fired dryers were significantly lower than the emissions from dryers fired with other fuels. No D-rated data were used for emission factor development. An emission factor rating of E was assigned to data sets with only one or two data points. An emission factor rating of D generally was assigned to data sets with three or more data points, and an emission factor rating of C generally was assigned to data sets with seven or more data points . The exception to this procedure was the factor for silver. Three data sets were available, but the data ranged over two orders of magnitude. Consequently, this candidate emission factor was assigned a rating of E.

Uncontrolled trace metals emission data also were available from one test on a fabric filter-controlled drum-mix dryer (Reference 356). The source was tested at the inlet and outlet to the fabric filter. The following table shows the results and calculated control efficiencies.

Besides the few exceptions described below, these uncontrolled emission factors also were incorporated into the AP-42 section with a data rating of E.

The Reference 340 test indicated zero antimony emissions at the inlet but $3.5x10^{-7}$ lb/ton of antimony at the outlet. Therefore, the uncontrolled antimony data were discarded. The uncontrolled emission factors for lead, nickel, and selenium from Reference 340 were higher than the candidate emission factors for controlled emissions of these metals. Therefore, the control efficiencies determined from the Reference 340 data were applied to the candidate factors for controlled emissions of these metals. These control efficiencies were 97, 95, and 86 percent for lead, nickel, and selenium, respectively. The Reference 340 test detected no mercury emissions at the inlet or outlet to the control device. Therefore, the uncontrolled emission factor was discarded. Finally, the Reference 340 data indicated that emissions of silver increased across the control device. Therefore, the uncontrolled silver data also were discarded.

FABRIC FILTER CONTROL EFFICIENCIES FOR METAL EMISSIONS – REFERENCE 356

Metal	No. of runs	Data rating	Emission factor, lb/ton		Control efficiency, %
			Fabric filter inlet	Fabric filter outlet	
Antimony	3	B	0	$3.50x10^{-7}$	a
Arsenic	3	A	$1.30x10^{-6}$	0	100.0
Barium	3	A	0.00025	$5.20x10^{-6}$	97.9
Beryllium	3	B	0	0	a
Cadmium	3	A	$4.20x10^{-6}$	$3.10x10^{-8}$	99.3
Chromium	3	A	$2.40x10^{-5}$	$1.10x10^{-6}$	95.4
Cobalt	3	A	$1.50x10^{-5}$	0	100.0
Copper	3	A	0.00017	$1.00x10^{-6}$	99.4
Lead	3	A	$2.30x10^{-5}$	$6.10x10^{-7}$	97.3
Manganese	3	A	0.00065	$8.30x10^{-6}$	98.7
Mercury	3	B	0	0	a
Nickel	3	A	$1.50x10^{-5}$	$7.40x10^{-7}$	95.1
Phosphorus	3	A	0.0012	$1.20x10^{-5}$	99.0
Silver	3	A	$2.70x10^{-7}$	$4.70x10^{-7}$	-74.1
Selenium	3	B	$1.20x10^{-7}$	$1.70x10^{-8}$	85.8
Thallium	3	A	$2.20x10^{-6}$	0	100.0
Zinc	3	A	0.00018	$3.10x10^{-6}$	98.3

[a] Pollutant not detected at inlet; control efficiency not calculated.

4.2.4.1.17 Dioxins and furans. Emission factors were developed for dioxins and furans using A- and B-rated data from two tests conducted on fuel oil- and waste-oil fired drum-mix dryers. Many of the individual compounds were not detected, and a value of zero was included in the average emission factors for those compounds. These emission factors are assigned E ratings because they are based on only two tests. Emission factors were developed for the following dioxins and furans: 2,3,7,8-tetrachlorodibenzo(p)dioxin (TCDD); 2,3,7,8-tetrachlorodibenzofuran (TCDF); 1,2,3,7,8-pentachlorodibenzo(p)dioxin (PeCDD); 1,2,3,7,8-pentachlorodibenzofuran (PeCDF); 2,3,4,7,8-PeCDF; 1,2,3,4,7,8-hexachlorodibenzo(p)dioxin (HxCDD); 1,2,3,6,7,8-HxCDD; 1,2,3,7,8,9-HxCDD; 1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF); 1,2,3,6,7,8-HxCDF; 1,2,3,7,8,9-HxCDF; 2,3,4,6,7,8-HxCDF; 1,2,3,4,6,7,8-heptachlorodibenzo(p)dioxin (HpCDD); 1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF); 1,2,3,4,7,8,9-HpCDF; total octachlorodibenzo(p)dioxin (OCDD); total octachlorodibenzofuran (OCDF); total TCDD; total TCDF; total PeCDD; total PeCDF; total HpCDD; total HpCDF; total HxCDD; total HxCDF; total PCDD; total PCDF; and total PCDD/PCDF.

4.2.4.1.18 Hydrochloric acid (HCl). An emission factor was developed for HCl emissions from five A-rated tests on fabric filter controlled drum mix dryers fired with drain or waste oil. The data range from 1.9×10^{-5} to 0.00023 kg/Mg (3.8×10^{-5} to 0.00045 lb/ton) and average 0.00010 kg/Mg to 0.00021 lb/ton. This emission factor is assigned a rating of D. Because fabric filters are not expected to control HCl emissions, this emission factor also can be used to estimate emissions from uncontrolled drum-mix dryers.

4.2.4.1.19 Other compounds. Emission factors were developed for 1-pentene, 2-methyl-1-pentene, 2-methyl-2-butene, 3-methylpentane, butane, ethylene, sulfuric acid (H_2SO_4), heptane, hexane, isooctane, methyl chloroform, and n-pentane emissions from fabric filter-controlled drum-mix dryers. These emission factors are based on one or two tests conducted on fuel oil- or waste oil-fired dryers. Fabric filters are not expected to control emissions of these pollutants; therefore, these emission factors can be used to estimate emissions from scrubber controlled drum-mix dryers as well. All of these emission factors are assigned E ratings because they are based on only one or two data points. Chlorobenzene, dichlorobenzene, and trichlorobenzene emissions were targeted and not detected during tests on three dryers.

4.2.4.2 Hot Oil Systems. Emission factors for HOS, which are the systems that heat the hot asphalt oil that is used in the production of HMA, were developed using the data presented in Table 4-13. Table 4-13a shows the development of emission factors for formaldehyde, CO, and CO_2 (pollutants for which more than one test is available). The formaldehyde, CO, and CO_2 emission factors for each test were calculated with units of kilogram per liter (kg/l) (pounds per gallon [lb/gal]) for oil-fired HOS and kilogram per standard cubic meter (kg/m^3) (pounds per standard cubic foot lb/ft^3) for natural gas-fired HOS. These emission factors then were normalized to a common basis, pounds per MMBtu (lb/MMBtu), so that the data for fuel oil-fired and natural gas-fired HOS could be compared and combined (if appropriate). The normalized average emission factors were then converted back to a kg/l (lb/gal) basis for fuel oil fired HOS and a kg/m^3 (lb/ft^3) basis for natural gas-fired HOS. The average emission factors for HOS are shown in Table 4-18. The following paragraphs describe the emission factor development.

Uncontrolled emission factors for PAHs and several polychlorinated dibenzofurans and dibenzo(p)dioxins, including 1,2,3,7,8,9-HxCDD, 1,2,3,4,7,8-HxCDD, total HxCDD, 1,2,3,4,6,7,8-HpCDD, total HpCDD, total OCDD, total TCDF, total PeCDF, total HxCDF, total HpCDF, 1,2,3,4,6,7,8-HpCDF, and total OCDF were developed from a single D-rated test. These emission factors are assigned E ratings.

Emission factors for uncontrolled formaldehyde emissions from HOS were developed from two A-rated and two B-rated tests conducted at four facilities. Data from one additional D-rated test, Reference 35, were not used for emission factor development because, as specified in the AP-42 procedures manual, C- or D-rated data should not be combined with A- or B-rated data. The formaldehyde data (from HOS fired by different fuels) were first normalized to a lb/MMBtu basis, and, because the emission factors were similar regardless of the HOS fuel type, the data from all four tests were combined to develop a single formaldehyde emission factor for HOS. This average lb/MMBtu emission factor then was converted back to a kg/l (lb/gal) basis for fuel oil-fired HOS and a kg/m^3 (lb/ft^3) basis for natural gas-fired HOS. These formaldehyde emission factors are assigned a C rating.

An emission factor for uncontrolled CO emissions from HOS was developed from three A-rated tests and one B-rated test conducted at four facilities. The CO data were first normalized to a lb/MMBtu basis, and the data from all four tests were combined to develop a single CO emission factor for HOS. The average lb/MMBtu emission factor then was converted back to a kg/l (lb/gal) basis for fuel oil-fired HOS and a kg/m^3 (lb/ft^3) basis for natural gas-fired HOS. The CO emission factors are assigned a C rating.

An emission factor for uncontrolled CO_2 emissions from HOS was developed from four B-rated tests conducted at four facilities. The CO_2 data were first normalized to a lb/MMBtu basis, and, because the emission factors were similar regardless of the HOS fuel type, the data from all four tests were combined to develop a single CO_2 emission factor for HOS. The average lb/MMBtu emission factor then was converted back to a kg/l (lb/gal) basis for fuel oil-fired HOS and a kg/m^3 (lb/ft^3) basis for natural gas-fired HOS. These CO_2 emission factors are assigned a C rating.

4.2.4.3 Batch-Mix Dryers. Emission factors for batch-mix dryers were developed using the data presented in Table 4-12. The average emission factors for drum-mix dryers are shown in Tables 4-19, 4-20, 4-21, and 4-22. All of the emission factors developed for batch mix dryers are assumed to represent the emissions from batch mix dryers as well as the hot screens and mixer that follow the dryers.

4.2.4.3.1 Filterable PM. An emission factor for uncontrolled filterable PM emissions from batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from two D-rated tests. Both tests were conducted on No. 2 fuel oil-fired dryers, but the data are assumed to represent filterable PM emissions from dryers firing all types of fuels except coal. The data range from 14 to 18 kg/Mg (27 to 37 lb/ton) and average 16 kg/Mg (32 lb/ton). This candidate emission factor is assigned an E rating.

An emission factor for filterable PM emissions from fabric filter-controlled batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 89 tests. The data range from 0.0012 to 0.090 kg/Mg (0.0024 to 0.18 lb/ton) and average 0.013 kg/Mg (0.025 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.017 kg/Mg (0.033 lb/ton) and the median is 0.0060 kg/Mg (0.012 lb/ton). Data from two C-rated tests (References 1 and 40) that were at the top or bottom of the range were excluded from the average because these two references provided only summary data on the emission tests that were conducted.

An emission factor for filterable PM emissions from venturi or wet scrubber-controlled batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 16 tests. The data range from 0.014 to 0.20 kg/Mg (0.027 to 0.40 lb/ton) and average 0.061 kg/Mg (0.12 lb/ton). This candidate emission factor is assigned a C rating. For this data set, the standard deviation is 0.053 kg/Mg (0.11 lb/ton) and the median is 0.049 lb/ton (0.098 lb/ton). The data from Reference 76 were not used because the control system, which consisted of dual wet scrubbers in series, was unique, and the data did not fall within the range of the data for the other wet scrubber-controlled batch mix dryers.

4.2.4.3.2 Size-Specific PM. For uncontrolled batch-mix dryers, no new particle size data are available. The particle size data from Reference 23 (the background document for the 1986 revision of the hot mix asphalt AP-42 section) were retained, although the data are outdated. To determine size specific emission factors, the percentages of PM-15, PM-10, PM-5, and PM-2.5 were multiplied by the emission factor for filterable PM from uncontrolled batch-mix dryers. The emission factor for PM-15 is 23 percent of 16 kg/Mg (32 lb/ton), or 3.7 kg/Mg (7.4 lb/ton). The emission factor for PM-10 is 14 percent of 16 kg/Mg (32 lb/ton), or 2.2 kg/Mg (4.5 lb/ton). The emission factor for PM-5 is 3.5 percent of 16 kg/Mg (32 lb/ton), or 0.56 kg/Mg (1.1 lb/ton). The emission factor for PM-2.5 is 0.83 percent of 16 kg/Mg (32 lb/ton), or 0.13 kg/Mg (0.27 lb/ton). These emission factors are assigned E ratings because the particle size data are based on D-rated data.

For PM-15 emissions from fabric filter-controlled batch-mix dryers, the particle size data from Reference 23 were reviewed, and data from one of the tests documented in Reference 23 (Reference 26 of Reference 23) were used to estimate the PM-15 percentage of filterable PM. The percentage of PM-15 is 47 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled batch-mix dryers. The candidate emission factor for PM-15 is 47 percent of 0.013 kg/Mg (0.025 lb/ton), or 0.0059 kg/Mg (0.012 lb/ton). This emission factor is assigned an E rating because the particle size data are based on a single test.

For PM-10 emissions from fabric filter-controlled batch-mix dryers, the particle size data from Reference 23 were reviewed, and data from one of the tests documented in Reference 23 (Reference 26 of Reference 23) were used in conjunction with data from Reference 24. The average percentage of PM-10 for the two tests is 39 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled batch-mix dryers. The candidate emission factor for PM-10 is 39 percent of 0.013 kg/Mg (0.025 lb/ton), or 0.0049 kg/Mg (0.0098 lb/ton). This emission factor is assigned an E rating because the particle size data are based on only two tests.

For PM-5 emissions from fabric filter-controlled batch-mix dryers, the particle size data from Reference 23 were reviewed, and data from one of the tests documented in Reference 23 (Reference 26 of Reference 23) were used to estimate the PM-5 percentage of filterable PM. The percentage of PM-5 is 36 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled batch-mix dryers. The candidate emission factor for PM-5 is 36 percent of 0.013 kg/Mg (0.025 lb/ton), or 0.0045 kg/Mg (0.0090 lb/ton). This emission factor is assigned an E rating because the particle size data are based on a single test.

For PM-2.5 emissions from fabric filter-controlled batch-mix dryers, the particle size data from Reference 23 were reviewed, and data from one of the tests documented in Reference 23 (Reference 26 of Reference 23) were used to estimate the PM-2.5 percentage of filterable PM. The percentage of PM-2.5 is 33 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled batch-mix dryers. The candidate emission factor for PM-2.5 is 33 percent of 0.013 kg/Mg (0.025 lb/ton), or 0.0041 kg/Mg (0.0083 lb/ton). This emission factor is assigned an E rating because the particle size data are based on a single test.

For PM-1 emissions from fabric filter-controlled batch-mix dryers, the particle size data from Reference 23 were reviewed, and data from one of the tests documented in Reference 23 (Reference 26 of Reference 23) were used to estimate the PM-1 percentage of filterable PM. The percentage of PM-1 is 30 percent. This percentage was multiplied by the emission factor for filterable PM from fabric filter-controlled batch-mix dryers. The candidate emission factor for PM-1 is 30 percent of 0.012 kg/Mg (0.024 lb/ton), or 0.0038 kg/Mg (0.0075 lb/ton). This emission factor is assigned an E rating because the particle size data are based on a single test.

4.2.4.3.3 Condensable organic PM. An emission factor for fabric filter- or venturi scrubber-controlled condensable organic PM emissions from batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 24 tests. The data range from 5.9×10^{-6} to 0.0091 kg/Mg (1.2×10^{-5} to 0.018 lb/ton) and average 0.0021 kg/Mg (0.0041 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.0021 kg/Mg (0.0042 lb/ton) and the median is 0.0013 lb/ton (0.0026 lb/ton).

4.2.4.3.4 Condensable inorganic PM. An emission factor for fabric filter- or venturi scrubber-controlled condensable inorganic PM emissions from batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 35 tests. The data range from 0.00037 to 0.060 kg/Mg (0.00073 to 0.12 lb/ton) and average 0.0065 kg/Mg (0.013 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 0.012 kg/Mg (0.024 lb/ton) and the median is 0.0021 lb/ton (0.0042 lb/ton).

4.2.4.3.5 Total condensable PM. Emission factors for total condensable PM emissions from fabric filter-controlled batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) were developed from one A-rated test and one B-rated test. The data range from 0.00036 to 0.0038 kg/Mg (0.00071 to 0.0076 lb/ton) and average 0.0021 kg/Mg (0.0042 lb/ton). This emission factor is not rated because much larger data sets are available for condensable organic and inorganic PM. Total condensable PM is calculated as the sum of the condensable organic and inorganic PM emission factors, which is 0.0084 kg/Mg (0.017 lb/ton). Data from References 46 and 240 for total condensable PM were not used because those references did not provide data for the organic and inorganic fractions separately.

4.2.4.3.6 Total PM and PM-10. The total PM emission factors shown in the AP-42 table represent the sum of the filterable PM, condensable organic PM, and condensable inorganic PM emission factors. These emission factors are rated the same as the lowest rated emission factor used in the summation. The total PM-10 emission factors shown in the AP-42 table represents the sum of the filterable PM-10, condensable organic PM, and condensable inorganic PM emission factors. These emission factors are rated the same as the lowest rated emission factor used in the summation.

The total PM data from References 15 and 40 were not used because both references provide summaries of test results and do not provide individual data points for the components that comprise total PM.

4.2.4.3.7 Carbon monoxide. An emission factor for uncontrolled CO emissions from batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from 12 tests. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce CO emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce CO emissions. The data range from 0.017 to 0.65 kg/Mg (0.033 to 1.3 lb/ton) and average 0.20 kg/Mg (0.40 lb/ton). This candidate emission factor is assigned a C rating. For this data set, the standard deviation is 0.24 kg/Mg (0.48 lb/ton) and the median is 0.075 kg/Mg (0.15 lb/ton).

4.2.4.3.8 Carbon dioxide. An emission factor for uncontrolled CO_2 emissions from batch-mix dryers (fired with natural gas, propane, butane, coal, fuel oil, or waste oil) was developed using data from 115 tests. The tests were conducted on fabric filter- or venturi scrubber-controlled dryers, but these control devices are not expected to reduce CO_2 emissions. The data range from 3.4 to 78 kg/Mg (6.9 to 160 lb/ton) and average 18 kg/Mg (37 lb/ton). This candidate emission factor is assigned an A rating. For this data set, the standard deviation is 11 kg/Mg (22 lb/ton) and the median is 16 lb/ton (32 lb/ton).

4.2.4.3.9 Nitrogen oxides. An emission factor for uncontrolled NO_x emissions from natural gas- or propane-fired batch-mix dryers was developed using data from three A-rated tests and one B-rated test. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce NO_x emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce NO_x emissions. The data range from 0.0071 to 0.020 kg/Mg (0.014 to 0.039 lb/ton) and average 0.013 kg/Mg (0.025 lb/ton). This emission factor is assigned a D rating.

An emission factor for uncontrolled NO_x emissions from fuel oil- or waste oil-fired batch-mix dryers was developed using data from one A-rated test and one B-rated test. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce NO_x emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce NO_x emissions. The data range from 0.031 to 0.084 kg/Mg (0.061 to 0.17 lb/ton) and average 0.058 kg/Mg (0.12 lb/ton). This emission factor is assigned an E rating.

4.2.4.3.10 Sulfur dioxide. An emission factor for uncontrolled SO_2 emissions from natural gas- or propane-fired batch-mix dryers was developed using data from two A-rated tests. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce SO_2 emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce SO_2 emissions. The data range from 0.0017 to 0.0029 kg/Mg (0.0034 to 0.0057 lb/ton) and average 0.0023 kg/Mg (0.0046 lb/ton). This emission factor is assigned an E rating.

An emission factor for uncontrolled SO_2 emissions from oil-fired batch-mix dryers was developed using data from A-rated tests on two fuel oil-fired and one waste oil-fired dryers. The tests were conducted on fabric filter-controlled dryers, but fabric filters are not expected to reduce SO_2 emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce SO_2 emissions. The emission factor is 0.044 kg/Mg (0.088 lb/ton). This emission factor is assigned an E rating.

An emission factor for uncontrolled SO_2 emissions from coal-fired batch-mix dryers (also using supplementary propane) was developed using data from a single A-rated test. The test was conducted on a fabric filter-controlled dryer, but fabric filters are not expected to reduce SO_2 emissions. This factor can also be used to estimate emissions from venturi scrubber-controlled dryers, because venturi scrubbers are not expected to reduce SO_2 emissions. The emission factor is 0.022 kg/Mg (0.043 lb/ton). This emission factor is assigned an E rating.

4.2.4.3.11 Total organic compounds. An emission factor for uncontrolled TOC (as propane) emissions from natural gas- or fuel oil-fired batch-mix dryers was developed using data from three A-rated tests and one C-rated test. This factor does not apply to No. 6 fuel oil or waste oil-fired dryers. The data range from 0.0044 to 0.010 kg/Mg (0.0087 to 0.021 lb/ton) and average 0.0073 kg/Mg (0.015 lb/ton). This candidate emission factor is assigned a D rating. Because the test method for TOC (Method 25A) does not measure formaldehyde emissions, actual TOC emission can be calculated by adding the formaldehyde emission factor for batch-mix dryers (0.00031 kg/Mg [0.00062 lb/ton]) to the candidate TOC factor.

An emission factor for uncontrolled TOC (as propane) emissions from No. 6 fuel oil-fired batch-mix dryers was developed using data from one A-rated test. The emission factor is 0.021 kg/Mg (0.043 lb/ton). This candidate emission factor is assigned an E rating. Because the test method for TOC (Method 25A) does not measure formaldehyde emissions, actual TOC emissions can be calculated by adding the formaldehyde emission factor for batch-mix dryers (0.00031 kg/Mg [0.00062 lb/ton]) to the candidate TOC factor.

4.2.4.3.12 Methane, benzene, ethylbenzene, toluene, and xylene. An emission factor for uncontrolled methane emissions from natural gas-, fuel oil-, or waste oil-fired batch-mix dryers was developed using data from two A-rated and two B-rated tests. The data range from 0.00058 to 0.0022 kg/Mg (0.0012 to 0.0043 lb/ton) and average 0.0037 kg/Mg (0.0074 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for uncontrolled benzene emissions from natural gas-fired batch-mix dryers was developed using data from two A-rated tests, one B-rated test, and one C-rated test. The data range from 3.5×10^{-5} to 0.00025 kg/Mg (7.0×10^{-5} to 0.00050 lb/ton) and average 0.00014 kg/Mg (0.00028 lb/ton). This candidate emission factor is assigned a D rating. Data from two additional C-rated tests are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

An emission factor for uncontrolled ethylbenzene emissions from natural gas- or fuel oil-fired batch-mix dryers was developed using data from one A-rated test, one B-rated test, and two C-rated tests. The data range from 0.00035 to 0.0028 kg/Mg (0.00070 to 0.0057 lb/ton) and average 0.0011 kg/Mg (0.0022 lb/ton). This candidate emission factor is assigned a D rating.

An emission factor for uncontrolled toluene emissions from natural gas- or fuel oil-fired batch-mix dryers was developed using data from one A-rated, one B-rated, and two C-rated tests. The data range from 3.7 x 10^{-5} to 0.00099 kg/Mg (7.3 x 10^{-5} to 0.0020 lb/ton) and average 0.00052 kg/Mg (0.0010 lb/ton). This candidate emission factor is assigned a D rating. Data from one additional C-rated test are not used because they are based on non-detect test runs, and the estimated emissions (one-half of the method detection limit was used to estimate emissions) are greater than the average of the tests that included actual measurements.

An emission factor for uncontrolled xylene emissions from natural gas- or fuel oil-fired batch-mix dryers was developed using data from one A-rated test, one B-rated test, and two C-rated test. The data range from 0.00035 to 0.0035 kg/Mg (0.00070 to 0.0069 lb/ton) and average 0.0014 kg/Mg (0.0027 lb/ton). This candidate emission factor is assigned a D rating.

4.2.4.3.13 Polynuclear aromatic hydrocarbons. Emission factors were developed for several PAHs, including 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene emissions from fabric filter-controlled batch-mix dryers fired by various fuels. In general, data from dryers fired by natural gas and No. 2 fuel oil were combined, and data from dryers fired by No. 6 fuel oil were presented separately. However, if the data indicated that emissions from No. 6 fuel oil-fired dryers are similar to emissions from natural gas- or No. 2 fuel oil-fired dryers, all of the data were combined. The emission factors that are based on only one or two tests are assigned E ratings, and the factors based on three or more tests are assigned D ratings. Table 4-22 shows the data combination for PAHs and other organic compounds.

4.2.4.3.14 Formaldehyde. An emission factor for uncontrolled formaldehyde emissions from batch-mix dryers (fired with natural gas, propane, fuel oil, or waste oil) was developed using data from five A-rated tests, one B-rated test, and one C-rated test. The data range from 3.8 x 10^{-5} to 0.0010 kg/Mg (7.6 x 10^{-5} to 0.0021 lb/ton) and average 0.00036 kg/Mg (0.00074 lb/ton). This candidate emission factor is assigned a D rating. Additional data from 10 D-rated tests were not used to develop this candidate emission factor.

4.2.4.3.15 Aldehydes and ketones. With the exception of formaldehyde (discussed in previous paragraph) and acetaldehyde (two tests), emission factors for all aldehydes and ketones were developed using data from a single test. Uncontrolled emission factors were developed for acetaldehyde, benzaldehyde, butyraldehyde/isobutyraldehyde, crotonaldehyde, hexanal, and quinone emissions from natural gas-fired batch-mix dryers. These emission factors are assigned E ratings. Data for acetone emissions were not used because of a high field blank.

4.2.4.3.16 Trace metals. Emission factors were developed for metals emissions from fabric filter- or venturi scrubber-controlled batch-mix dryers (fired with natural gas, fuel oil, or waste oil). Data for venturi scrubber-controlled dryers and waste oil-fired dryers were only available to quantify lead emissions. For the most part, the data did not show any significant differences between fuel types. Therefore, most of the data were combined regardless of fuel type. However, separate emission factors were developed for lead emissions from natural gas- or fuel oil-fired dryers and waste oil-fired dryers, because the data indicate that lead emissions from waste oil-fired dryers are an order of magnitude greater than lead emissions from natural gas- or fuel oil-fired dryers. All available A-, B-, and C- rated data were combined for the following metals: arsenic, barium, beryllium, cadmium, chromium, copper, hexavalent chromium, manganese, mercury, nickel, selenium, and zinc. The emission factor ratings and data combination are shown in Table 4-21. The emission factors that are based on three or more tests are assigned D ratings, and the factors that are based on less than three tests are assigned E ratings.

4.2.4.4 Conventional: Continuous Mix Facilities. Emission factors were not developed for continuous mix asphalt plants.

4.3 STATISTICAL APPROACH *(NOTE: THE STATISTICAL ANALYSES DESCRIBED IN THIS SECTION DO NOT INCLUDE DATA FROM REFERENCES BEYOND REFERENCE NUMBER 338)*

In addition to the traditional approach, the hot mix asphalt data also were analyzed by statistical methods to evaluate the effects of the design and operating parameters for which data were available on emission factors. Data were analyzed using two general approaches: two-sample t-tests and general linear model techniques (which encompass analysis of variance and regression models). The t-tests were used to determine if the mean value for two data sets differed significantly according to a specific categorical variable. Categorical variables are those that assume discrete (typically nonnumeric) values. For this study, the categorical variables included emission control device (fabric filter or scrubber), scrubber type (venturi or unspecified wet scrubber), fuel type (oil or gas), and oil class (waste oil/No. 6 fuel oil or other types of fuel oil). If the data did not provided statistical evidence that mean emission factors for two classes differed, the data sets were combined for subsequent analyses. For example, if a t-test did not indicate that the mean emission factor for CO emissions from oil-fired dryers differed significantly from the mean emission factor for CO from gas-fired dryers at a statistically significant level, fuel type was ignored, and the data for both fuels were grouped together for the subsequent analyses of the CO data. There were two advantages to grouping the data in this manner. First, grouping data simplified the full linear model by reducing the number of potential values a categorical variable could assume. Second, by combining two groups of data, the sample size increased, thereby increasing the power to identify important effects of different parameters on emissions.

The general methodology for determining the potential effects of the categorical variables was first to determine the potential effect of fuel type on emissions, then the potential effect of emission control device on emissions. To eliminate the potential effect of control device while assessing fuel effects, control device was held constant. That is, the fabric filter data and the scrubber data were grouped separately and separate t-tests were performed on the fabric filter data and on the scrubber data. In addition, to eliminate the potential effect of RAP content on emissions, the t-tests were performed only for those data points for which the RAP content was less than 0.1 (i.e., less than 10 percent RAP). However, it should be noted that there were few data points for which RAP was used, but at quantities less than 10 percent.

The general linear model techniques were used to determine the effects of continuous variables on emissions. Continuous variables are those that take on numerical values; the continuous variables considered in the analysis of the hot mix asphalt data were the RAP content of the mix (e.g., 0.2 for 20 percent RAP), production rate, and scrubber pressure drop (for the scrubber-controlled filterable PM data only).

To expedite the process, box plots and scatter diagrams were used to help characterize the emission factors by providing insight on the distribution and variability of the data. As an example, Figure 4-1 shows a box plot of batch mix, fabric filter-controlled, filterable PM emission factors by fuel type. The box extends from the 25th to the 75th percentile; this range is known as the interquartile range. The line across the box represents the median (or 50th percentile) of the data. The horizontal lines above and below each box extend to the upper and lower adjacent values. The upper adjacent value is defined as the largest data point less than or equal to the 75th percentile plus 1.5 times the interquartile range; the lower adjacent value is defined as the smallest data point greater than or equal to the 25th percentile minus 1.5 times the interquartile range. Observed points more extreme than the adjacent values are plotted individually. In addition, the width of the box is proportional to the number of data points in the category.

For each set of analyses, the final linear model was developed through an investigator-driven elimination process. Based on preliminary descriptive results, such as those described earlier for t-tests, initial models included all pertinent parameters (i.e., the main effects) that could have an effect on emissions and the interactions (or cross-products) of those parameters. By interaction is meant the product of two parameters, such as production rate multiplied by the RAP content in the mix. After the initial model was fit, the model was reduced hierarchically. First, all interaction terms that were determined to be nonsignificant were eliminated, and the model was fit again. Then, the nonsignificant main effects were eliminated from the model, and the model was fit again.

Statistical analyses were performed on the data for the following pollutants: filterable PM, condensable inorganic PM, condensable organic PM, VOC, CO, CO_2, NO_x, and SO_2. The data on emissions of other pollutants were inadequate for the analyses to be meaningful.

For the t-tests and the general linear models, a significance level of 0.10 was used for all statistical decisions; the p-values calculated by the statistical tests were compared to this significance level. That is, p-values of 0.10 or less indicated a significant effect, and p-values greater than 0.10 indicated no significant effect on emissions. Although this level provides less Type I error protection than is achieved by the 0.05 level of significance often used, this value was selected to improve the power of the analyses (i.e., to reduce the likelihood of a Type II error). A Type II error results when the analysis fails to find that a factor affects emissions when it actually does. In the context of these analyses, a Type II error would occur if, for example, the analyses indicated that control device had no effect on emissions, when, in fact, control device did affect emissions significantly. Type II errors are considered to be at least of equal importance as Type I errors in developing AP-42 emission factors.

The following sections summarizes the results of the analyses of the batch mix and drum-mix data by pollutant. The complete results of each t-test performed and each linear model fit to the data on batch mix and drum-mix emission data are presented in Appendices A and B, respectively. As can be seen from the analyses, the linear models developed from the data generally explained less than half of the variability in the data. For this reason, an additional analysis of the data was performed to determine if multiplicative models might be more appropriate than linear models for explaining data variability. The results of this analysis is presented in Section 4.3.3. Finally, the filterable PM data were analyzed to determine the type of statistical distribution that best describes the data. A discussion of this analysis is presented in Section 4.3.4.

4.3.1 Batch-Mix Dryers

The following paragraphs describe the results of the analyses of the batch mix emissions data. Table 4-23 summarizes the results of the t-tests performed on the batch mix data, and Table 4-24 summarizes the predictive equations developed from the batch mix emissions data. The complete results the analyses are presented in Appendix A.

4.3.1.1 Filterable PM. The first step in the analyses of the filterable PM data was to use a t-test to determine if firing batch-mix dryers with waste oil resulted in a significant difference in emissions when compared to emissions from dryers fired with fuel oil. To eliminate the potential effect of control device, the data for fabric filter-controlled dryers and scrubber-controlled dryers were analyzed separately. In addition, to eliminate the potential effect of RAP, only the data for which the RAP content was less than 0.1 were considered. The mean emission factors for fabric filter-controlled filterable PM were 0.021 lb/ton for waste oil-fired dryers and 0.028 lb/ton for dryers fired with other types of fuel oil. The t-test indicated no significant difference ($p = 0.59$) in these two emission factors. The analyses of the data on scrubber-controlled emissions yielded a similar result. The mean emission factor for waste-oil fired dryers (0.17 lb/ton) did not differ significantly from the mean factor for nonwaste oil-fired dryers

(0.042 lb/ton), and the p-value for the t-test was 0.34. (It should be noted that the lack of statistical significance is related to a lack of statistical power because of small sample sizes – 5 tests total – rather than a lack of meaningful technical difference in emissions.) Based on these results, the data for all types of fuel oil, including waste oil, were combined for the subsequent analyses.

Next, a comparison was made to determine if there was a significant difference in filterable PM emissions for oil-fired dryers when compared to emissions from gas-fired dryers. Again, the potential effects of control device and RAP content were eliminated by analyzing the fabric filter data separately from the scrubber data and by considering only those data points for which the RAP content was less than 0.1. The mean emission factors for fabric filter-controlled filterable PM were 0.025 lb/ton for oil-fired dryers and 0.016 lb/ton for gas-fired dryers. The t-test indicated no significant difference ($p = 0.25$) in these mean emission factors. Figure 4-1 presents a boxplot of the fabric filter-controlled filterable PM data by fuel type for batch mix plants. For scrubber controlled emissions, the mean emission factors were 0.12 lb/ton for oil-fired dryers and 0.21 lb/ton for gas-fired dryers. The t-test indicated no significant difference ($p = 0.53$). For the subsequent analyses, fuel type was ignored.

The effect of control device was examined next. The t-test indicated that fabric filter-controlled filterable PM emissions (0.020 lb/ton) differed significantly ($p = 0.078$) from scrubber-controlled filterable PM emissions (0.15 lb/ton) for RAP content less than 0.1, as would be expected. Figure 4-2 presents a boxplot of the filterable PM data by control device for batch mix plants.

Finally, the scrubber data were analyzed to determine if the mean emission factor for venturi scrubber-controlled dryers (0.11 lb/ton) differed significantly from the mean emission factor for dryers controlled with unspecified wet scrubbers (0.25 lb/ton). The results indicated no significant difference ($p = 0.34$), despite the fact that the mean emission factor for venturi scrubber-controlled emissions was less than half the mean factor for unspecified wet scrubber-controlled emissions. Again, the lack of statistical power associated with the small data sets is the likely explanation for this result.

Based on the results of the t-tests described above, separate linear models were fit for the fabric filter data and the scrubber data. The mean emission factor for fabric filter-controlled filterable PM was found to be a function of the RAP content ($p = 0.0067$) and the production rate ($p = 0.033$). However, the squared correlation coefficient (R^2) value for the model is 0.22, which indicates that the model explains only a small percentage of the variability in the data. The model can be expressed as follows:

$$EF_{PM} = 0.043 + 0.14R - 0.00012P \tag{4-1}$$

where:

EF_{PM} = emission factor for fabric filter-controlled filterable PM emissions in lb/ton;
R = RAP content; and
P = is the production rate in ton/hr.

A separate model was fit to predict fabric filter-controlled filterable PM emissions as a function of RAP content only ($p = 0.0043$). This model has a squared correlation coefficient of 0.15 and can be expressed as:

$$EF_{PM} = 0.020 + 0.16R \tag{4-2}$$

where:

EF_{PM} = emission factor for fabric filter-controlled filterable PM emissions in lb/ton; and
R = RAP content.

Neither of the two models for fabric filter-controlled filterable PM emissions (Equations 4-1 and 4-2) explains much of the variability in the data. It should be noted that the large difference in the constant terms for the two equations (0.043 for Equation 4-1 and 0.020 for Equation 4-2) is that Equation 4-2 is based on an average production rate for the data; if a production rate of 200 ton/hr is used with Equation 4-1, the two models give comparable results.

Filterable PM emissions from scrubber-controlled batch-mix dryers were found to vary according to production rate ($p = 0.039$). The model has an R^2 value of 0.48 and is presented as Equation 4-3 below.

$$EF_{PM} = 0.35 - 0.00094P \qquad (4\text{-}3)$$

where:

EF_{PM} = emission factor for scrubber-controlled filterable PM emissions in lb/ton; and
P = is the production rate in ton/hr.

4.3.1.2 Condensable Inorganic PM. The data on emissions of condensable inorganic PM were analyzed using the same methodology as described above for the filterable PM data analysis. In all cases, the t-tests indicated no difference in the means of the groups for which comparisons were made. That is, both fuel type and emission control device were found to have no effect on condensable inorganic PM emissions.

Two models for estimating condensable inorganic PM emissions were developed from the data. In the first model, emissions were found to vary according to the cross-product of RAP content and production rate ($p < 0.0001$). The model has an R^2 value of 0.77 and can be expressed as follows:

$$EF_{CIPM} = 0.0041 + 0.00054RP \qquad (4\text{-}4)$$

where:

EF_{CIPM} = emission factor for condensable inorganic PM emissions in lb/ton;
R = RAP content; and
P = is the production rate in ton/hr.

In the second model, emissions were found to vary according to the RAP content ($p = 0.0001$). The model has an R^2 value of 0.61 and can be expressed as follows:

$$EF_{CIPM} = 0.0050 + 0.079R \qquad (4\text{-}5)$$

where:

EF_{CIPM} = emission factor for condensable inorganic PM emissions in lb/ton; and
R = RAP content.

A closer examination of the data indicates that both of the models for condensable inorganic PM emissions are driven by the three data points for which RAP content was greater than zero; that is, of the 17 data points for condensable inorganic PM emissions, the RAP content was zero for 14 of the data points. For this reason, these models are not recommended for incorporation into AP-42. The effect of the nonnegative RAP data points on the mean emission factor is evident from Figure 4-3, which presents a plot of the condensable inorganic PM data by RAP content for batch mix plants.

4.3.1.3 Condensable Organic PM. The results of the t-tests performed on the condensable organic PM data were similar to the results of the condensable inorganic PM data analysis; both fuel type and emission control device were found to have no effect on emissions. Figure 4-4 depicts a boxplot of the condensable organic PM data by fuel type for batch mix plants. It should be noted that for most of the comparisons, the data sets were relatively small.

From an engineering perspective, one would expect emissions from waste-oil fired dryers to be higher than emissions from nonwaste oil-fired dryers. In fact, the mean emission factor for condensable organic emissions from waste-oil fired dryers (0.0077 lb/ton for fabric filter control) was nearly 3 times the mean emission factor for nonwaste oil-fired dryers (0.0027 lb/ton). However, because of the small data sets, the t-test could not be used to substantiate this difference in terms of statistical significance.

Emissions were found to vary according to RAP content ($p = 0.011$) and the cross-product of RAP content and production rate ($p = 0.030$). The model has an R^2 value of 0.35 and can be expressed as follows:

$$EF_{COPM} = 0.0044 + 0.065R - 0.00018RP \qquad (4\text{-}6)$$

where:

EF_{COPM} = emission factor for condensable organic PM emissions in lb/ton;
R = RAP content; and
P = is the production rate in ton/hr.

As was the case for condensable inorganic emissions, this model is driven by a few data points; the RAP content was zero for 5 of the 19 data points upon which the model is based. For this reason, Equation 4-6 also is not recommended for inclusion in AP-42.

4.3.1.4 Volatile Organic Compounds. For VOC emissions, there were a total of 5 data points for which the RAP content was specified. All of the data were derived from tests on fabric filter-controlled drum-mix dryers, so an analysis of control device effect was not possible. However, comparison of the oil-fired dryer data to the gas-fired dried data indicated that fuel type had no significant effect on VOC emissions. The number of data points were too few to allow a meaningful linear model analysis.

4.3.1.5 Carbon Monoxide. For CO emissions, there were a total of 10 data points, all resulting from tests on fabric filter-controlled batch-mix dryers. Although an analysis of control device effect was not possible, the emission controls used in the hot mix industry are unlikely to have any effect on CO emissions. The analysis indicated that none of the other parameters (fuel type, RAP content, and production rate) had a significant effect on CO emissions.

4.3.1.6 Carbon Dioxide. Neither control device nor fuel type were found to impact CO_2 emissions significantly. Figure 4-5 presents a boxplot of the CO_2 data by fuel type for batch mix plants. The linear model analysis indicated that CO_2 emissions can be estimated as a function of RAP content ($p = 0.052$), production rate ($p = 0.0002$), and the RAP content-production rate cross-product ($p = 0.043$). However, the squared correlation coefficient (R^2) value for the model is 0.23, which indicates that the model explains only a small percentage of the variability in the data. The model can be expressed as follows:

$$EF_{CO2} = 75 - 170R - 0.18P + 0.67RP \qquad (4\text{-}7)$$

where:

EF_{CO2} = emission factor for CO emissions in lb/ton;
R = RAP content; and
P = is the production rate in ton/hr.

A second model developed from the CO_2 data indicates CO_2 emissions can be estimated as a function of production rate alone (p = 0.0009). This model has an even smaller R^2 value of 0.12 and can be expressed as follows:

$$EF_{CO2} = 59 - 0.10P \tag{4-8}$$

where:

EF_{CO2} = emission factor for CO emissions in lb/ton; and
P = is the production rate in ton/hr.

Both of the two models developed for CO_2 emissions explain little of the variation in the data. Figure 4-6 presents a plot of the CO_2 data by production rate for batch mix plants.

4.3.1.7 Nitrogen Oxides. The data for NO_x emissions from batch-mix dryers were too few to model (six data points total). A comparison of NO_x emissions from oil-fired dryers (2 data points with a mean of 0.12 lb/ton) and NO_x emissions from gas-fired dryers (4 data points with a mean of 0.025 lb/ton) indicated no significant difference in mean emission factors, despite the considerable difference in the mangnitudes of the mean emission factors. Again, the lack of statistical power due to small data sets is the likely explanation for this outcome.

4.3.1.8 Summary of Recommended Emission Factor Equations. The equations that were developed for batch mix facilities are not recommended for inclusion in the revised AP-42 section because of the consistently low correlation coefficients. The large amounts of data that were analyzed did not show any meaningful relationships between the emission factors and the parameters that were examined. This is indicative of an industry with large amounts of variability between plants.

4.3.2 Drum-Mix Dryers

The following paragraphs describe the results of the analyses of the drum-mix emissions data. Table 4-25 summarizes the results of the t-tests performed on the drum-mix data, and Table 4-26 summarizes the predictive equations developed from the drum-mix emissions data. The complete results the analyses are presented in Appendix B.

4.3.2.1 Filterable PM. The same methodology was used to analyze the drum-mix data as is described for the batch mix data analysis discussed in Section 4.3.1. However, scrubber pressure drop data also were available for some of the drum-mix emission tests. The t-tests indicated that only control device significantly affected filterable PM emissions (p = 0.015); the mean emission factor for fabric filter-controlled PM determined to be 0.014 lb/ton, and the mean emission factor for scrubber-controlled PM was calculated as 0.026 lb/ton. Figure 4-7 depicts a boxplot of the filterable PM data by control device, and Figure 4-8 depicts a boxplot of the fabric filter-controlled filterable PM data by fuel type for drum mix plants.

As indicated in Table 4-25, the mean emission factors for many of the t-test comparisons showed significant differences, even though the statistical tests indicated otherwise. This type of results are due mainly to a lack of statistical power associated with small data sets and the large variability in the data. For example, for scrubber-controlled filterable from waste oil-fired dryers, the mean emission factor was calculated as 0.047 lb/ton, and, for scrubber-controlled filterable PM from dryers fired with nonwaste fuel oil, the mean emission factor was 0.021 lb/ton. Yet, the statistical test indicated no significant difference ($p = 0.18$) in mean emission factors. In addition, comparisons of the means of the various emission factors classes considered were not always consistent from engineering perspective. For example, for fabric filter-controlled filterable PM from waste oil-fired dryers, the mean emission factor (0.0095 lb/ton) was much smaller in magnitude than the corresponding mean emission factor for dryers fired with nonwaste oils (0.016 lb/ton).

The linear model analysis indicated that neither of the continuous variables modeled (RAP content, production rate) had a significant effect on filterable PM emissions. Furthermore, analysis of the scrubber data indicated that the effect of scrubber pressure drop on filterable PM emissions also was negligible.

4.3.2.2 Condensable Inorganic PM. The analysis of the data on emissions of condensable inorganic PM indicated that neither fuel type nor emission control device had significant effect on emissions. The linear model analysis indicated that both RAP content and production rate had no significant effect on condensable inorganic PM emissions.

4.3.2.3 Condensable Organic PM. The results of the t-tests performed on the condensable organic PM data were similar to the results of the condensable inorganic PM data analysis; both fuel type and emission control device were found to have no significant effect on emissions. Figure 4-9 presents a boxplot of the condensable organic PM data by fuel type for drum mix plants. This result is due largely to the lack of statistical power associated with the analysis of small data sets; for several of the comparisons, one of the classes compared had only 2 data points, as indicated in Table 4-25.

Emissions were found to vary according to RAP content ($p = 0.047$). However, the value of the squared correlation coefficient (0.11) for the model indicates that the model is of limited use in estimating emissions. The model can be expressed as follows:

$$EF_{COPM} = 0.0074 + 0.033R \qquad (4\text{-}9)$$

where:

EF_{COPM} = emission factor for condensable organic PM emissions in lb/ton; and
R = RAP content.

This model is consistent with engineering principles in that one would expect the condensable organic emissions to increase with increasing RAP content. However, the squared correlation coefficient of 0.11 indicates that the model explains very little of the variability in the data.

4.3.2.4 Volatile Organic Compounds. The analysis of the VOC emission data indicated no fuel effect ($p = 0.28$). However, the data do indicate that control device has a significant effect on emissions ($p = 0.060$). For those data points for which the RAP content was less than 0.1, the mean emission factor for fabric filter-controlled VOC was 0.015 lb/ton, and the mean emission factor for scrubber-controlled VOC was 0.058 lb/ton. This result is not consistent with engineering principles in that, if either of the two control devices has an effect on VOC emissions, one would expect larger emissions reductions from scrubber control than from fabric filter control. It should be noted that the data sets compared were very small; there were 4 data points for fabric filter-controlled VOC emissions and 3 data points for scrubber-controlled VOC emissions. For these reasons, the revised AP-42 section does not segregate the drum-mix VOC emission factor by control device.

The scrubber-controlled data were too few to model (3 data points total). For the fabric filter-controlled VOC data, RAP content was found to have no significant effect on emissions, but the analysis indicated a marginal effect for production rate ($p = 0.092$). The model developed has an R^2 value of 0.28 and can be expressed as follows:

$$EF_{VOC} = 0.11 - 0.00022P \qquad (4\text{-}10)$$

where:

EF_{VOC} = emission factor for fabric filter-controlled VOC emissions in lb/ton; and
P = production rate in ton/hr.

Figure 4-10 presents a plot of the VOC data by production rate for drum mix plants.

4.3.2.5 Carbon Monoxide. For CO emissions, there were a total of 11 data points, all of which were derived from tests on fabric filter-controlled drum-mix dryers. Although an analysis of control device effect was not possible, the emission controls used in the hot mix industry are unlikely to have any effect on CO emissions. The analysis indicated that none of the other parameters (fuel type, RAP content, and production rate) had a significant effect on CO emissions.

4.3.2.6 Carbon Dioxide. The analysis of the CO_2 emission data generally indicated that none of the parameters considered had a significant effect on emissions. Figure 4-11 depicts a boxplot of the CO_2 data by fuel type for drum mix plants. The one exception to this result pertained to the data for fabric filter-controlled CO_2. For this data set, the mean emission factor for oil-fired dryers (32 lb/ton) was found to differ significantly ($p = 0.016$) from the mean emission factor for gas-fired dryers (25 lb/ton). However, because the magnitude of the two emission factors are comparable and the scrubber-controlled data indicated no such difference by fuel type, the factors for CO_2 were not segregated by fuel type in the revised AP-42 section.

4.3.2.7 Nitrogen Oxides. The NO_x emission data all were derived from tests on fabric filter-controlled dryers. The analysis indicated that fuel had no significant effect on NO_x emissions. The data were to few for the linear model analyses to produce meaningful results; there were a total of 5 data points for which the RAP content was specified.

4.3.2.8 Sulfur Dioxide. The analysis of the SO_2 emission data indicated that none of the parameters considered had a significant effect on emissions.

4.3.2.9 Summary of Recommended Emission Factor Equations. The equations that were developed for drum-mix facilities are not recommended for inclusion in the revised AP-42 section because of the consistently low correlation coefficients. The large amounts of data that were analyzed did not show any strong relationships between the emission factors and the parameters that were examined. This is indicative of an industry with large amounts of variability between plants.

4.3.3 Applicability of Multiplicative Models

In regression terminology, a multiplicative model is one in which errors (or deviations of the emission factor about the predictive regression line or surface) are multiplicative rather than additive. In such cases these deviations are expressed as a multiple or percentage of the modeled emission factors rather that as ± some value. If multiplicative models are appropriate, those models can be fit by log transforming the emission factor before modeling. One way to determine whether multiplicative models might be appropriate is to examine the residuals (actual emissions - predicted emissions from the model) as a function of the predicted emissions for an additive model. Patterns of residuals in which greater variability is associated with larger predicted emission factors are indicative of a multiplicative model. For the hot mix asphalt data, residuals did not exhibit strong patterns of increased variability with increasing predicted values, suggesting no need for further examination of multiplicative models.

4.3.4 Filterable PM Distributions

Exploratory data analysis techniques, including both graphical descriptions via histograms and formal tests of distributional fit using Kolmogorov type statistics, were used to assess distributional properties of the filterable PM data for hot mix asphalt plants with separate analyses for batch and drum-mix facilities. Analyses were conducted on two different variables, the actual emission factors and the residuals from the emission factor models deemed to provide best fit. Because the normality requirements for statistical inference in regression models are related to the "error term" in the model, not to the observations themselves, these analyses focused on the residuals, which are the best estimates of the model "errors." Examination of the histograms of the residuals showed the distribution to be relatively symmetric, with a slight skewness to the right. The Kolmogorov tests showed the data to be nonnormal, a finding that is likely to be related to the slight skewness and to somewhat greater weight in the tails than is found in the normal distribution. However, the distribution was quite unimodal, and given the sample sizes for both types of hot mix plant and the robustness of the regression results to departures from normality that don't exhibit extreme bimodality, the results appear reasonable.

The distributions of the actual emission factors also were examined, and the factors themselves generally were lognormally distributed or nearly so. The lognormal distribution is one bounded by zero on the left and skewed to the right. This finding is not surprising and is not inconsistent with the above findings in that emissions are a function of RAP content and production rate, both of which appear to be somewhat skewed to the right.

4.4 EMISSIONS FROM HMA LOAD-OUT AND OTHER SOURCES

This section summarizes the review of emission test reports and other documents that address emissions from the HMA load-out, batch plant silo filling, truck emissions, and other sources. Two of the references (References 355 and 356) provided data that were valid for developing emission factors. The results of the analyses of the Reference 355 and 356 emission data are presented below. All of the references reviewed are discussed in Section 4.2.1.

The test data from these two tests documented in References 355 and 356 require a number of adjustments before they can be compared or combined. First, the reported load-out emissions data from Plant C includes emissions measured during production operations and one test that quantified emissions due to truck operations without asphalt loading. Second, the "volatility" of the asphalts used at Plant C and Plant D are different and should be adjusted to some consistent value. Third, the load-out temperatures for each run at Plant C and Plant D were somewhat different and should be adjusted to some consistent value. The following sections describe the basis for performing these adjustments to arrive at load-out and silo filling emissions at a standardized temperature and asphalt volatility. This allows the two load-out data sets to be compared and, where appropriate, combined.

4.4.1 Load-Out Emissions

Tables 4-27 and 4-28 summarize the results of the load-out tests at Plants C, and Table 4-29 summarizes the load-out test results for Plant D. The following paragraphs discuss the data and the corrections made to the data in the process of developing load-out emission factors.

4.4.1.1 Background correction. Emissions data were collected at Plant C during a background test to estimate emissions from the operation of diesel trucks in the absence of hot mix asphalt loading. This data allows for the adjustment of the run-by-run load-out data for PM (both MCEM and non-MCEM fractions), VOHAPs), SVOHAPs, polynuclear aromatic hydrocarbons (PAHs), and TOC. Capture efficiency was measured during the production tests and the background test. Capture efficiency-corrected emissions data were presented in the test reports and was incorporated in the emission calculations.

A number of methods to adjust for these background concentrations are possible. The most reliable method to adjust for emissions measured during background operations would be to separately adjust each run for the measured capture efficiency and then subtract these adjusted background emissions from the adjusted emissions measured during production operations. This procedure produces negative values for both the PM and MCEM and many other HAP compounds. This situation is probably due to a combination of factors which cannot be accommodated retroactively. An approach that utilizes the capture efficiency data that were collected, accounts for the emissions from diesel trucks and paved roadways, minimizes the number of negative emission values, and provides a high bias relative to the most correct method mentioned above was used to account for background emissions. To accomplish this, the as-measured background concentration was subtracted from each separate capture efficiency adjusted run. For the most part, values were treated as zero if the background concentration exceeded the capture-efficiency-adjusted run concentration. Emissions of particulate presented the one exception. If the background-adjusted PM is less than the MCEM, the value for the MCEM was used in lieu of the background-adjusted PM. This background adjustment method resulted in a low estimate for the background emissions, and, therefore, emission factors for load-out that are conservatively high.

It should also be noted that the full run average TOC emission concentration of 1.2 ppm was not used for the background adjustment for truck emissions. Instead, the average concentration of 0.83 for the first half of the background run was used. While the second half of the background run had average concentrations of 1.6 ppm, the capture efficiency was generally lower. This situation could not be fully explained and it was agreed to use the lower concentrations for the background adjustment.

Background adjusted emission factors were calculated by subtracting the measured background concentration from the capture efficiency corrected concentration and then multiplying by the ratio of the capture efficiency corrected emission factor to the capture efficiency-corrected concentration. An example calculation using Run 1 MCEM emissions is presented below:

$$EF_{cor} = [(C_{prod}) - (C_{back})] \times \frac{EF_{prod}}{C_{prod}}$$

where:

EF_{cor} = Background corrected emission factor (lb/ton).
C_{prod} = Capture efficiency corrected production concentration (gr/dscf).
C_{back} = Measured background concentration (gr/dscf).
EF_{prod} = Capture efficiency corrected emission factor (lb/ton).

The following values were obtained from Table 4-27:

C_{prod} = 1.68×10^{-3} gr/dscf (from MCEM row, second column).
C_{back} = 3.78×10^{-4} gr/dscf (from MCEM row, eighth column).
EF_{prod} = 3.12×10^{-4} lb/ton (from MCEM row, third column).

$$EF_{cor} = ((1.68 \times 10^{-3}) - (3.78 \times 10^{-4})) * (3.12 \times 10^{-4} / 1.68 \times 10^{-3})$$
$$= 1.30 \times 10^{-3} * 1.86 \times 10^{-1}$$
$$= 2.42 \times 10^{-4}$$

The background-corrected load-out emission factors calculated for Plant C are presented in Tables 4-30 and 4-31.

4.4.1.2 Adjustment for asphalt volatility. Samples of the asphalt binder used during each test run were collected. The mass loss-on-heating of these samples were determined according to ASTM Method D 2872-88, Effects of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test - RTFOT). This test determines the loss-on-heating of an asphalt sample following heating at 325°F for five hours. During the test, a small amount of the asphalt is maintained in a rolling vessel which causes a thin film of the asphalt to be exposed. This test is performed by industry prior to other physical tests that measure the suitability of the asphalt as a binder for paving material. As a result of industry and state quality control programs, this test is performed on many samples of asphalt throughout the distribution and use cycle of asphalt binders. It also seems reasonable to expect organic air emissions from asphalt to be directly proportional to the loss-on-heating measured by this test. However, it should be noted that this relationship is uncertain but is assumed to be directionally correct since the basic physical processes that the asphalt binder experiences in the production of HMA and during the rolling thin film test are similar. As a result, it follows that all emission factors related to the organic content of asphalt binders (includes VOHAPs, SVOHAPs, PAHs, TOC, and MCEM PM) should be scaled to common RTFOT results for each test run before comparing emissions or combining emissions to a single result. However, the inorganic PM from stone dust or unpaved road dust (non-MCEM PM) should not be scaled to RTFOT results, since asphalt volatility would have no effect on these emissions.

To determine a common RTFOT value to use as a default in those situations where no historical information is available, a survey of laboratories of a limited number of State departments of transportation was performed. Information that was requested included the results of RTFOT tests performed by the laboratory. Data for calendar year 1999 were obtained from Massachusetts, Connecticut, North Carolina, Michigan, and Minnesota. Each of the state transportation department laboratory employees who provided these data said that they analyze asphalts used or projected for use without further blending or modifications. Information on the rolling thin film tests for Plant C and D and for selected States where data from 1999 were obtained are presented in Table 4-32. Also included are the number of samples tested and the standard deviation of the loss-on-heating values.

Based upon the RTFOT data in Table 4-32 and the desire to select a default which encourages the use of site-specific data, a default of -0.5 percent was used. The adjustment due to asphalt volatility was performed after correcting for capture efficiency and truck background emissions. Emission factors for individual test runs were normalized to a 0.5 percent loss-on-heating by multiplying the CE and background-corrected emission factor by the ratio of asphalt volatility measured during the individual test runs to 0.5 percent. Data from Plant C and Plant D were adjusted to this default value prior to comparing the data, determining whether to combine the data into a single factor, and in combining the data. In addition, in the revised AP-42 section, it is highly recommended that any adjustments for the loss-on-heating be an appropriate statistical calculation of a representative sampling of asphalts used in the location in question. Selection of the appropriate statistical calculation should also be based upon the pollutants and health endpoints being evaluated. The adjustment of the data based upon the maximum loss-on-heating value allowed by some general specification is not appropriate, nor is the selection of the maximum loss-on-heating value obtained for any one sample.

4.4.1.3 Adjustment for asphalt temperature. Because asphalt binders are typical of many other organic substances, temperature can have an effect on the emissions. Supplemental laboratory analyses were performed on the asphalt binder obtained during both Plant C and D emissions tests. These tests can be used to estimate the relative significance of this temperature effect. The analyses for loss-on-heating performed on the asphalts used during the tests included temperatures 25°F above and below the ASTM reference temperature of 325°F. The results of these analyses are presented in Table 4-33. As indicated by these tests, the loss-on-heating can change almost by a factor of 2 with these changes in temperature.

A fundamental physical phenomenon described by the Clausius-Clapeyron equation states that there is a linear relationship between the natural log of the vapor pressure and the inverse of the absolute temperature (Reference: Experimental Physical Chemistry; F. Daniels, J. W. Williams, P. Bender, R. Alberty, and C. Cornwell; McGraw-Hill; 1962). Many engineering texts and manuals (Handbook of Chemistry and Physics; 45th Edition; CRC Press; June 1973) provide Antoine's equation constants describing this linear relationship for many compounds. Using the data in Table 4-33, the constants describing this relationship for the asphalts used during the tests were empirically developed. Using the actual Plant C and D data, we can relate temperature to the loss-on-heating by using the following two equations, where t equals temperature (°F):

California Asphalt: $\text{Loss} = -\,e^{((t + 460)*0.0231 - 19.28)}$

Massachusetts Asphalt: $\text{Loss} = -\,e^{((t + 460)*0.0271 - 22.93)}$

During stakeholder meetings to discuss the collection and analysis of this data, the industry has stated that good paving practices dictate that load-out temperatures in excess of 325°F should be avoided. More specifically, the Asphalt Pavement Environmental Council's published "Best Practices" brochure (Figure 4-12) published on 4/00 provides guidance for controlling fumes, emissions, and odors from HMA plants and paving operations. The second side of the brochure (Figure 4-13) includes recommendations for the range and midpoint temperatures for both the storage of asphalt and the mixing of the HMA product. These temperatures vary by asphalt binder grade. The numbers in the binder grade are indications of the project-specific temperature extremes (in degrees centigrade) for which the asphalt mixture is designed. As such, a PG82-22 grade asphalt is intended for use when average 7-day maximum pavement design temperature is 82°C (179°F) and the minimum pavement design temperature is 22°C (-8°F). The midpoint HMA plant mixing temperatures range from 264°F to 315°F. As shown in Figure 4-13, the highest HMA mixing temperature is associated with a binder used for the most severe temperature conditions.

In an attempt to maximize the emissions from the silo filling and load-out operations, both facilities were requested to increase the load-out temperature as much as possible. However, as indicated by the average temperatures measured during the tests, a consistent temperature was not achieved. The equations developed from the additional laboratory testing of the asphalt binders used during the emission tests provide a mechanism to normalize the emissions to the maximum temperature of 325°F. This can be accomplished by multiplying the capture efficiency and background corrected emissions by the ratio of the loss-on-heating at 325°F to the estimated loss-on-heating at the temperature measured during the test run. Thus, all organic emission factors related to the asphalt binders (includes VOHAPs, SVOHAPs, PAHs, TOC, and MCEM PM) can be scaled according to these temperature relationships. It should be noted that this hypothesis has not been validated by emissions testing but provides an adjustment that is directionally correct. It should also be noted that it is not appropriate to scale the inorganic particulate matter from stone dust or unpaved road dust (non-MCEM PM) to the asphalt temperature, since asphalt temperature has no effect on these emissions.

For Plant C load-out data, the adjustment to a consistent asphalt volatility and temperature was performed after correcting for capture efficiency and truck background emissions. (Note: For Plant C silo filling data, which is discussed in a following section, the adjustment to a consistent asphalt volatility and temperature was performed on the measured emissions.) The emission factors for Plant C were normalized to a loss-on-heating of -0.5 percent and a load-out temperature of 325°F using Equation 4-11. For Plant D load-out data, the adjustment to a consistent asphalt volatility and temperature was performed on the measured emissions as no correction for capture efficiency or truck background emissions was required. The emission factors for Plant D were normalized to a loss-on-heating of -0.5 percent and a load-out temperature of 325°F using Equation 4-12.

Equation 4-11:

$$EF_{Std} = EF_{Corr} \left(\frac{-0.5}{V}\right) \left[\frac{e^{((0.0231)(325 + 460) - 19.28)}}{e^{((0.0231)(T + 460) - 19.28)}}\right]$$

Equation 4-12:

$$EF_{Std} = EF \left(\frac{-0.5}{V}\right) \left[\frac{e^{((0.0271)(325 + 460) - 22.93)}}{e^{((0.0271)(T + 460) - 22.93)}}\right]$$

where:

Ef_{std} = Emission factor, lb/ton, at standard conditions of 0.5 percent loss-on-heating and 325°F.
EF = Emission factor, lb/ton.
V = Asphalt volatility, where a 0.5 percent loss-on-heating is expressed as "-0.5." Determined by ASTM Method D2872-88.
T = Asphalt temperature,°F.

Tables 4-34 and 4-35 present the temperature and volatility-adjusted emissions data for Plant C load-out; Table 4-36 presents the temperature and volatility-adjusted emissions data for Plant D load-out. It should be noted that these emissions do not include the particulate deposition estimates. Speciation profiles for individual HAP species also are included in the tables for Plant C in addition to the emissions estimates. Because the HAP species would also be a portion of the PM-based pollutants deposited on the ventilation system, the speciation profiles will allow for an improved characterization of the total uncontrolled emissions.

To provide a measure of asphalt fumes condensing on load-out facility surfaces and air handling ductwork, several deposition plates were placed for collection of particulate matter. Deposition plates were installed prior to the test program and were removed following the entire test series. The PM collected by the deposition plates was recovered and analyzed as stated in EPA Method 315 for both MCEM and non-MCEM components. The PM plate deposition then was scaled by multiplying the sample catch by the ratio of the facility surface area to the test plate surface area. Further details of the sampling procedures, calculations, and quantitations are contained in the PES Plant C test report. In general, however, the deposition plates provided a single PM value for the entire test series, which was converted to an emission factor by using the load-out tons for all plant operations during that time period.

Because MCEM PM is associated with the organic fraction (i.e. asphalt binder), Method 315 data from each run (MCEM PM fraction only) were adjusted for asphalt temperature and volatility, as described previously in this section. Similarly, the MCEM PM fraction for the deposition data was adjusted for average asphalt temperature and volatility (since run-by-run deposition data were not available). The capture efficiency-corrected MCEM PM deposition data for Plant C was 8.68×10^{-6} lb/ton, and the MCEM deposition data for Plant D was calculated to be 3.58×10^{-6} lb/ton. By using Equation 4-11, the volatility and temperature-corrected MCEM deposition estimate for Plant C is 1.93×10^{-5} lb/ton. In like manner using Equation 4-12, the volatility and temperature-corrected MCEM deposition estimate for Plant D is 8.77×10^{-6} lb/ton. The final emission factor is the sum of the temperature and volatility adjusted MCEM PM from both the Method 315 and deposition data. The resulting temperature and volatility adjusted MCEM PM emission factor for Plant C is 1.62×10^{-4} lb/ton and for Plant D is 5.18×10^{-4} lb/ton.

The non-MCEM PM or inorganic PM was determined in a manner similar to MCEM PM described above, except that the non-MCEM portion of the PM catch was not adjusted for asphalt temperature or volatility. The reason for this is that the non-MCEM PM represents stone dust in the emissions or road dust emissions, and these type of PM emissions are not affected by asphalt conditions. The inorganic PM is calculated by taking the difference between the PM and MCEM emissions for both the background corrected emissions and the deposition estimate. The inorganic PM deposition for Plant C was 1.25×10^{-4} lb/ton. For Plant D, the inorganic PM deposition was 3.01×10^{-5} lb/ton. For Plant C, the sum of the inorganic PM measured by sampling and deposition is 1.81×10^{-4} lb/ton. For Plant D, this sum is 1.15×10^{-3} lb/ton. Although most of the diesel truck exhaust was excluded from Plant D's enclosure and ventilation system, the fugitive dust created by truck movement on the unpaved surfaces could not be excluded. This may partially explain why the inorganic PM at Plant D is much higher than from Plant C. Since no background run was performed at Plant D, an adjustment for background dust emissions due to truck movement can not be made.

After adjusting the load-out emissions for Plant C and D to a common volatility and temperature reference, the data were compared to determine whether to present separate emission factors for batch and drum-mix plants or to average the data and present on one emission factor for both types of plants. Table 4-37 presents the PM, MCEM, inorganic PM and TOC data adjusted to a common loss-on-heating value of -0.5 percent and a common load-out temperature of 325°F.

4.4.2 Silo Filling Emissions

Tables 4-38 and 4-39 summarize the results of the silo filling tests at Plants C. The analysis and adjustment of the silo filling test data were performed as described in the previous section for the load-out data. However, since there was no background correction, the adjustment to a consistent asphalt volatility and temperature was performed on the measured emissions. The adjusted data are presented in Tables 4-40 and 4-41. For Plant C, the reported deposition for silo filling was 7.1×10^{-5} for PM and 1.12×10^{-6} for MCEM PM. The volatility and temperature adjusted deposition values are 7.26×10^{-5} for PM and 2.49×10^{-6} for MCEM PM. The resulting temperature and volatility adjusted PM and MCEM PM emission factors for silo filling are 5.85×10^{-4} and 2.53×10^{-4} respectively.

4.4.3 Comparison of Load-Out Data for Plants C and D

The most significant difference in emissions between Plant C and D is the inorganic PM emissions. The inorganic PM emissions from Plant D are almost ten times the emissions from Plant C. In addition, the inorganic PM is 1.6 times the MCEM PM compared to Plant C where the inorganic PM is approximately the same as the MCEM PM for both the silo filling and load-out operations. This large difference is probably due in part to the added dust emissions from the gravel paving surface. Using the

AP-42 Section 13.2.2 for unpaved roads, an estimate of dust emissions can be made. Information on the vehicle weight, road silt content, road moisture content and vehicle speed are needed to use the equation presented in the AP-42 section. Approximately 25 tons of asphalt was loaded into trucks that weighed about 10 tons for an average weight of about 22 tons. Based upon the default silt content for publicly accessible gravel roads of 6.4 percent, an assumed moisture content of 15 percent and an average vehicle speed of 5 miles per hour (mph) the emission factor in pounds per vehicle mile traveled (vmt) can be calculated.

$$E = k \frac{(s/12)^{0.8} (W/3)^{0.5}}{(M/0.2)^{0.4}}$$

where:

k = a constant which is 10 for total particulate
s = silt content (%)
W = average vehicle weight (tons)
M = average surface moisture (%)

Solving the above equation using the above variables yields an emission factor of 2.91 lb/vmt. Since the enclosure was about 150 feet long (0.028 mi) and the average hot mix asphalt loaded was 25 tons, 0.00114 miles were traveled in the enclosure for every ton loaded. Also since the vehicle speed was less than 5 mph, the AP-42 section recommends an adjustment of 5/15 to estimate emissions from vehicles traveling at slow speeds. Multiplying the emission factor in lb/vmt by 0.00114 to convert to lb/ton and by 5/15 to accommodate the slow speeds yields an emission factor of 1.11×10^{-3} lb/ton. Subtracting this emission factor from the inorganic PM emissions measured at Plant D yields a background corrected emission factor of 1.5×10^{-4}. While this adjustment is speculative, it agrees well with the background adjusted inorganic particulate emission factor for Plant C. As a result, the inorganic PM emission factor for Plant C of 1.81×10^{-4} lb/ton will be used for both batch mix plants and drum-mix plants.

The next most significant difference in emissions between Plant C and D is the MCEM PM. The MCEM PM from Plant D is approximately four times the emissions from Plant C. This difference could be explained by the longer time required to complete the load-out operations at batch plants compared to drum-mix plants and other test-specific factors. However, the asphalt dependant mechanism that generates emissions of MCEM PM and TOC is the same for both pollutants. This volatilization should cause similar MCEM PM and TOC load-out emissions after adjustments for asphalt volatility and temperature. Both emissions are the result of vaporization of organic material from the asphalt binder. The more volatile organic material remains a vapor and is measured by Method 25A and generally is referred to as TOC. The less volatile organic material condenses into an aerosol and is measured by Method 315 and is referred to as MCEM PM. When summed, the TOC and MCEM PM emissions from Plant D are only 13 percent higher than the TOC and MCEM PM emissions from Plant C. Given the variations in the run-by-run data, the low number of runs, and the uncertainty in adjusting emissions to a consistent temperature and volatility, the difference is not significant. Therefore, for the purposes of developing emission factors for load-out operations, both the MCEM PM and TOC data from Plant C and Plant D were averaged and an equation that represents the averaged data was developed.

4.4.4 Predictive Emission Factor Equations for Load-Out and Silo Filling Operations

The equations used to adjust the Plant C and Plant D emissions data to a common temperature and volatility condition are specific to the asphalts used during those emissions tests. To arrive at a single equation that accounts for the physical characteristics of both asphalts requires some additional adjustment to the RTFOT data. Accounting for differences in the loss-on-heating of the asphalts is straightforward since it was assumed that emissions are directly related to the loss-on-heating. Accounting for differences in the temperature of the asphalts is more complicated due to the non-linear relationship between temperature and loss-on-heating that was used. The temperature relationship can be developed in the same manner that the plant specific equations relating temperature to loss-on-heating were developed. First, the predicted loss-on-heating for each asphalt was calculated using the plant-specific equations. Next, the predicted values were adjusted to a loss-on-heating at 325°F of -0.5 percent. Table 4-42 presents the predicted and the adjusted loss-on-heating values for asphalts from both tests. Next, the adjusted loss-on-heating values were averaged for each temperature. Then a linear regression of the temperature (converted to °R by adding 460) and the natural logarithm of the adjusted loss-on-heating (expressed as a positive number to avert a calculation error) was performed to determine the equation constants. The results of the linear regression produce the following equation.

$$\text{Loss-on-heating} = e^{((0.0251(T+460)) - 20.43)}$$

The loss-on-heating equation developed from the adjusted data from asphalts obtained during emissions testing at Plant C and D can be used to develop predictive equations for total PM, organic PM (MCEM PM), TOC and CO. The following sets of equations present the development of the predictive equations for use in the AP-42 Section.

For total PM from load-out operations from drum-mix or batch mix plants :

$$\text{Total PM} = 1.81\ E-04 + 3.40E-04\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{e^{((0.0251)(325+460)-20.43)}}\right]$$

$$= 1.81\ E-04 + 3.40E-04\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{0.4836}\right]$$

$$= 1.81\ E-04 + 1.41E-03\ (-V)\ e^{((0.0251)(T+460)-20.43)}$$

For organic PM from load-out operations from drum-mix or batch mix plants:

$$\text{Organic PM} = 3.40\ E-04\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{e^{((0.0251)(325+460)-20.43)}}\right]$$

$$= 3.40\ E-04\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{0.4836}\right]$$

$$= 1.41\ E-03\ (-V)\ e^{((0.0251)(T+460)-20.43)}$$

For TOC from load-out operations from drum-mix or batch plants:

$$\text{TOC} = 4.15\ E-03\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{e^{((0.0251)(325+460)-20.43)}}\right]$$

$$= 4.15\ E-03\ \left(\frac{V}{-0.5}\right)\left[\frac{e^{((0.0251)(T+460)-20.43)}}{0.4836}\right]$$

$$= 1.72\ E-02\ (-V)\ e^{((0.0251)(T+460)-20.43)}$$

For CO from load-out operations from drum-mix or batch plants:

$$CO = 1.35\ E-03\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{e^{((0.0251)\ (325\ +\ 460)\ -\ 20.43)}}]$$

$$= 1.35\ E-03\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{0.4836}]$$

$$= 5.58\ E-03\ (-V)\ e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}$$

For total PM from silo filling:

$$Total\ PM = 3.32\ E-04 + 2.53\ E-04\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{e^{((0.0251)\ (325\ +\ 460)\ -\ 20.43)}}]$$

$$= 3.32\ E-04 + 2.53\ E-04\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{0.4836}]$$

$$= 3.32\ E-04 + 1.05\ E-03\ (-V)\ e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}$$

For organic PM from silo filling:

$$Organic\ PM = 2.53\ E-04\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{e^{((0.0251)\ (325\ +\ 460)\ -\ 20.43)}}]$$

$$= 2.53\ E-04\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{0.4836}]$$

$$= 1.05\ E-03\ (-V)\ e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}$$

For TOC from silo filling:

$$TOC = 1.22\ E-02\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{e^{((0.0251)\ (325\ +\ 460)\ -\ 20.43)}}]$$

$$= 1.22\ E-02\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{0.4836}]$$

$$= 5.04\ E-02\ (-V)\ e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}$$

For CO from silo filling:

$$CO = 1.18\ E-03\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{e^{((0.0251)\ (325\ +\ 460)\ -\ 20.43)}}]$$

$$= 1.18\ E-03\ (\frac{V}{-0.5})\ [\frac{e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}}{0.4836}]$$

$$= 4.88\ E-03\ (-V)\ e^{((0.0251)\ (T\ +\ 460)\ -\ 20.43)}$$

Emission factors for individual compounds quantified during emission testing at Plant C should be presented as a percentage of either the organic PM or the TOC for load-out emissions and for silo filling emissions. Tables 4-43 and 4-44 present the speciation profiles to be used to estimate emissions of the PM- based and the volatile organic-based compounds, respectively.

4.4.5 Storage Tank Emissions

Methodologies are available to estimate emissions from heated organic liquid storage tanks (see Organic Liquid Storage Tanks in Chapter 7 of AP-42 and the TANKS software). The emissions from these types of tanks depend on the contents of the tank, the volume of gas vented, and the operating temperature range of the liquid in the tank. Emissions during the filling of these tanks (working loss) are governed by the saturation concentration of the liquid stored in the tank and the volume of gas displaced by the addition of liquid to the tank. Emissions during other periods (breathing losses) are governed by the saturation concentration of the liquid stored in the tank and the changes in the volume of the gas caused by temperature variations. However, vapor pressure information on paving asphalt is not available to allow the use of the TANKS program without additional information.

Information is available in the test report for Plant C to infer emissions during the filling of the asphalt storage tank and, by extension, the vapor pressure characteristics of paving asphalt at the typical operating temperatures. The derivation is based upon the assumption that emissions from the storage tanks and the silo vent are saturated and are at the maximum concentration possible for the temperature maintained. As a result, organic compound emissions (TOC, MCEM, VOHAPS, and SVOHAPS) occur at the same concentrations as the maximum measured from the silo vent. Knowledge of the mass (volume) of asphalt transferred into the storage tank can be used to determine the volume of gas and, therefore, mass emissions from the storage tank during filling operations. With this information, an aliphatic hydrocarbon, exhibiting equivalent working loss emissions, can be added to the TANKS chemical database. Following this general procedure, the specific parameters required to estimate the breathing loss emissions can be determined using the following nine steps.

First, the TOC concentration at saturation in the head space of the asphalt binder storage tanks is estimated at a specific temperature. This concentration can be estimated from the maximum TOC concentration measured from the HMA storage silos at Plant C. This concentration is determined as follows:

Two episodes of “pegged” TOC readings occurred during Run 3 (the emissions being measured exceeded the maximum concentration of 1,000 ppm that the instrument was capable of measuring). One was for a 10-min period from 0723 to 0733, and one was a 4-min period from 0841 to 0845. Two other episodes occurred and lasted 1 min. Using the slope of the lines on either side of the “pegged” readings, an estimate of the “unmeasured” emission was determined graphically from the Run 3 TOC time plot (Figure 4-14). A maximum concentration of about 1800 ppm is estimated for the 0723 to 0733 time period. This estimate is considered to be an upper-bound estimate for the following reasons:

1. Data from Run 1 and 2 also show fairly steep curves on both sides of a plateau that is below the 1,000 ppm maximum reading of the instrument. Figure 4-15 shows data from Run 2 typical of both runs. As can be seen, there is a very steep curve that plateaus at about 500 ppm. Extrapolating this curve shows a peak value near 2,000 ppm, a situation not shown by the actual data for this run.

2. Despite the steep curves seen in Run 3, several on-scale readings were observed immediately before and after the “pegged” readings, indicating that the true peak was likely just beyond the instrument span of 1,000 ppm. Specifically, these readings were 856 ppm at 0722, 811 ppm at 0734, 994 at 0840, and 982 ppm at 0845.

The average silo emission duct concentration and mass emission rate reported for Run 3 in Table 3-7 were 590 ppm and 2.3 lb/hr respectively. Also, as reported for Run 3 in Table 3-5, the volumetric flow was 574 dscfm. Therefore the measured TOC concentration for Run 3 was 6.678×10^{-5} lb/dscf (2.3 lb/hr ÷ (574 dscfm x 60 hr/min = 0.00006678 lb/dscf). The equivalency for a 2,000 ppm concentration was determined by using the ratio of lb/dscf to ppm measured during the complete Run 3 (2,000 ppm x (6.678×10^{-5} ÷ 590 ppm) = 2.264×10^{-4}). Therefore, a TOC concentration of 2,000 ppm is equivalent to 0.000226 lb/ft^3.

Second, the volume of vapor displaced from the asphalt binder storage tank by the mass of asphalt binder used to manufacture a given quantity of HMA is determined. The volume of displaced vapor is determined as follows:

During the TOC excursion which occurred during Run 3 Between 7:00am and 8:30am on July 27 Plant C was making HMA that averaged 4.9 percent asphalt binder. At this ratio, 4,900 tons of asphalt binder is used in the production of 100,000 tons of virgin asphalt pavement (100,000 x 0.049 = 4,900). At a density of 69 lb/ft^3, the volume of vapor displaced from the storage tank by this 4,900 tons of asphalt binder is 142,029 cubic feet (ft^3) (4,900 x 2,000 ÷ 69 = 142,029).

Third, the mass of organic compounds emitted from the asphalt binder storage tank during filling operations (working loss) per 100,000 tons of HMA is determined. The mass emissions are determined by multiplying the estimated concentration of organic compounds at saturation by the estimated vapor displaced from the asphalt binder storage tank during the production of 100,000 tons of HMA. As a result, the asphalt storage tank emissions during filling would be 32 lb/100,000 tons of asphalt production (0.000226 lb/ft^3 x 142,029 ft^3/100,000 tons HMA = 32.15 lb/100,000 tons HMA).

Fourth, the physical properties of the asphalt required for the TANKS program to calculate working loss emissions are determined. The TANKS program requires the liquid density in lb/gal, the liquid molecular weight, and the vapor molecular weight. Converting density from lb/ft^3 to lb/gal gives 9.22 lb/gallon (69 lb/ft^3 ÷ 7.481 ft^3/gal = 9.22). Data presented in the document *SHRP Materials Reference Library: Asphalt Cements: A Concise Data Compilation* (SHRP-A-645; Strategic Highway Research Program; National Research Council; Washington, DC; May 1993) indicates that the liquid molecular weight of asphalts from single crude oil sources ranges from 700 to 1300 g/g-mole. Therefore, a median liquid molecular weight of 1,000 g/g-mole is a reasonable value for liquid asphalt. Additionally, information from the FTIR analysis during the testing at Plant C indicated that the vapor spectra were very similar to aliphatic hydrocarbons between pentane and nonane. Therefore, vapor molecular weights between 72 g/g-mole and 129 g/g-mole are reasonable.

Fifth, the TANKS program requires information on the dimensions, operating temperature, and throughput for the storage tank. The recorded temperature for the material being loaded into the HMA storage silo on July 27, 1998 at 7:36 was 325° F. This temperature was used as the average bulk liquid temperature and average liquid surface temperature. It was assumed that the temperature of the liquid in the storage tank varied 5° F above and below the average temperature. The following tank properties and throughput were used in the TANKS software program:

Tank Length	50 feet	Tank Working Volume	18,000 gallons
Tank Diameter	8 feet	Net Throughput	1,062,000 gallons
Number of Turnovers	59		
Shell Color	Gray/Med	Shell Condition	Good
Avg. Liquid Surface Temperature	325°F	Bulk Liquid Temperature	325°F
Min. Liquid Surface Temperature	320°F	Max. Liquid Surface Temperature	330°F

Sixth, the TANKS program requires the relationship between temperature and vapor pressure for the material stored. For materials stored at temperatures greater than 120° F, TANKS requires the constants for one of the two forms of Antoine's equations identified in the TANKS documentation. The TANKS program does not have a compound where the vapor pressure relationship is defined by either Antoine's equations, the liquid molecular weight is near 1,000 and the vapor molecular weight is between 72 and 129. Therefore, recent versions of the Handbook of Chemistry and Physics and Lange's Handbook of Chemistry were consulted for Antoine's constants for aliphatic hydrocarbons that are less volatile than are currently in the TANKS chemical data base. Neither handbook contained Antoine's constants in either form for aliphatic hydrocarbons less volatile than eicosane ($C_{20}H_{42}$). However, the 45th Edition of the Handbook of Chemistry and Physics (June 1973) included a table titled, "Vapor Pressures, Critical Temperatures and Critical Pressures of Organic Compounds." This table provided a temperature and vapor pressure relationship defined by two constants and included aliphatic hydrocarbons up to nonacosane ($C_{29}H_{60}$). The documentation in TANKS calls one form of the equation "Antoine's equation (using °K)" and provides the following equation defining the relationship between temperature and vapor pressure:

$$\text{Log } P = (-0.05223\ A) / T) + B$$

where:

log (P) = the logarithm (base 10) of the vapor pressure (P)
P = vapor pressure in mm Hg
T = temperature for vapor pressure determination in °K (°C + 273)

The Antoine's constants for heavier aliphatic hydrocarbons were added to the TANKS software program. Two compounds were added to the chemical data base for each available set of Antoine's constants. A liquid molecular weight of 1,000 was specified for both compounds. A vapor molecular weight of 72 was specified for one compound and 129 for the other compound.

Seventh, the TANKS program was run for a variety of the aliphatic hydrocarbons added to the TANKS chemical database. The aliphatic hydrocarbons which resulted in emissions nearest to 32 lb/year were docosane ($C_{22}H_{46}$) and tricosane ($C_{23}H_{48}$). The TANKS program calculates emissions of 36.4 lb/year for docosane (vapor molecular weight of 85 g/g-mole) and 29.3 lb/year for tricosane (vapor molecular weight of 129 g/g-mole).

Eighth, since neither compound resulted in calculated emissions near 32 lb per year, a revised set of Antoine's constants was required. The above calculated emissions are approximately equally above and below the calculated working loss emissions of 32 lb/year. For the TANKS program to calculate working loss emissions of 32 lb/year, Antoine's constants that more closely estimate these emissions were developed by averaging the docosane and tricosane Antoine's constants. The constants for docosane and tricosane (using °K) are 70871.7 and 79828.43, for "A" and 8.604918 and 9.402 for "B" (Reference: *Handbook of Chemistry and Physics;* 54th Edition; CRC Press; June 1973). The "A" and "B" terms were averaged and resulted in Antoine's constants (using °K) values of 75350.06 for "A" and 9.00346 for "B." These Antoine's constants were added to the TANKS chemical database.

Ninth, the TANKS program was run using various vapor molecular weights between 85 and 129 to obtain the vapor molecular weight that resulted in emissions closest to 32 lb/year. The molecular weight that resulted in these emissions was 105 g/g-mole. Using the above Antoine's constants and a vapor molecular weight of 105 in the TANKS program results in annual working losses of 32.76 lb/year and breathing losses of 1.73 lb/year. Therefore, these values will be presented in AP-42 as estimated Antoine's constants and average liquid and vapor molecular weights for the purposes of calculating emissions from asphalt storage tanks. Because these constants were derived using technology transfer, the emission factor developed will be rated E.

Asphalt storage tank working and breathing losses of CO can be estimated using the TOC losses calculated using the TANKS program and the predictive emission factor equations for TOC and CO emissions from silo filling operations presented in the previous section. The only difference between the two equations is value of the initial coefficient, which is 0.0504 for TOC and 0.00488 for CO. The ratio of these coefficients (0.00488/0.0504) is 0.097. Therefore, CO emissions from asphalt storage tank working and breathing losses can be estimated by multiplying the TOC losses by a factor of 0.097.

4.4.6 Emissions Following Load-Out – Yard Emissions

Table 4-4 of the Plant D report presented EPA Method 25A TOC data from eight extended period tests in an attempt to determine a static emission rate. The average emission rate at the end of the extended period tests for all eight tests was 0.19 lb/hr and for the seven tests that were greater than 4-min in duration was 0.18 lb/hr of TOC. The average asphalt in the trucks used during this test was 27 tons. For the tests of greater than 4-min duration the average asphalt in the trucks was 29 tons. These tests were conducted immediately following the load-out operation. Since the complete capture of load-out emissions relied upon the capture of emissions that were collected directly from the asphalt and on additional fumes that escaped immediate capture but were retained in the enclosure some of the emissions measured during these tests could also be attributed to the load-out operation. Due to the potential for measuring residual emissions in the enclosure, the data for this test are rated D.

Figure 4-16 shows time plots of the extended period test results. Note that the 3-min extended period test data were dropped from consideration since all other test data are from 5 to 7 min in duration. Additionally, it is apparent that the six data sets demonstrate a consistent downward trend. Several curve fits in Lotus and Excel were attempted on this data set, but the downward trend of the data presented problems for these programs.

Successive emission rates for each data set were added to obtain cumulative emissions over time. Figure 4-17 shows the cumulative emission (total grams) versus time after loading for each of these sampling periods. For the scale shown, much of the data appear to be nearly linear, although some of the data and the previously noted tail-off indicate that a nonlinear function may be more valid. Both linear and nonlinear functions were investigated. Table 4-45 summarizes the best curve fits for the linear and nonlinear functions. All three of these functions are plotted on Figure 4-17 with the data sets and are described in the following paragraphs.

Note that these equations may not hold beyond 5 to 7 min for several reasons. First, no data are available past eight minutes and, as with all extrapolations, estimates beyond the available data are highly speculative. Second, as described in Reference 389, Response 53, emissions are highly dependent on temperature. The asphalt will cool and the emission rate will be further reduced. It is expected that these equations will provide emission estimates that are biased higher with increasing time. Because of the consistent downward trend in the data, we believe that the linear equation is an upper-bound estimate of emissions. The power function equation is believed to provide the least biased emissions estimate within the constraints of the data. However, the linear and power equations can be used to show a range of the upper-bound estimate of yard emissions. Cumulative emissions were calculated at the 5-, 8-, and 10-minute points and are included in the Table 4-46. These times should be typical of the times that trucks are in the vicinity of the production and loading operations.

"R-squared" is a mathematical term used to numerically define how well the curve fits the data, and a value greater than 0.9 is considered good. Of the three equations presented in Table 4-45, the power function provides the closest analogy to the appearance of the original measured emission rates and will be presented in the AP-42 section. Rather than presenting the equation, the emission factor for the 8-minute time period (0.011 lb/ton) will be presented in the AP-42 section. Due to the potential problems associated with properly collecting and analyzing this emission source, the factor is E rated.

Yard emissions of CO can be estimated using the emission factor for TOC emissions from yard emissions (0.011 lb/ton) and the predictive emission factor equations for TOC and CO emissions from load-out presented in the previous section. The difference between the two equations is value of the initial coefficient, which is 0.0172 for TOC and 0.00558 for CO. The ratio of these coefficients (0.00558/0.0172) is 0.32. Therefore, yard CO emissions can be estimated using the emission factor of 0.0035 lb/ton. This emission factor also is assigned a rating of E.

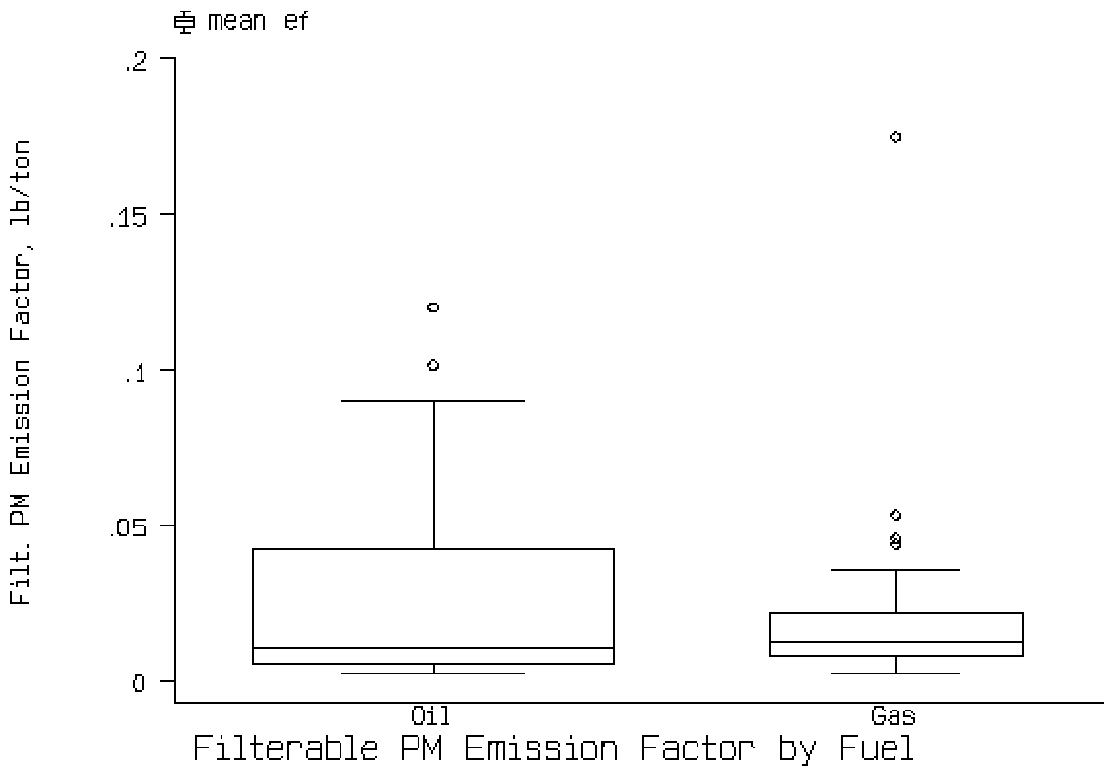

Figure 4-1. Boxplot of fabric filter-controlled filterable PM by fuel type for batch mix plants.

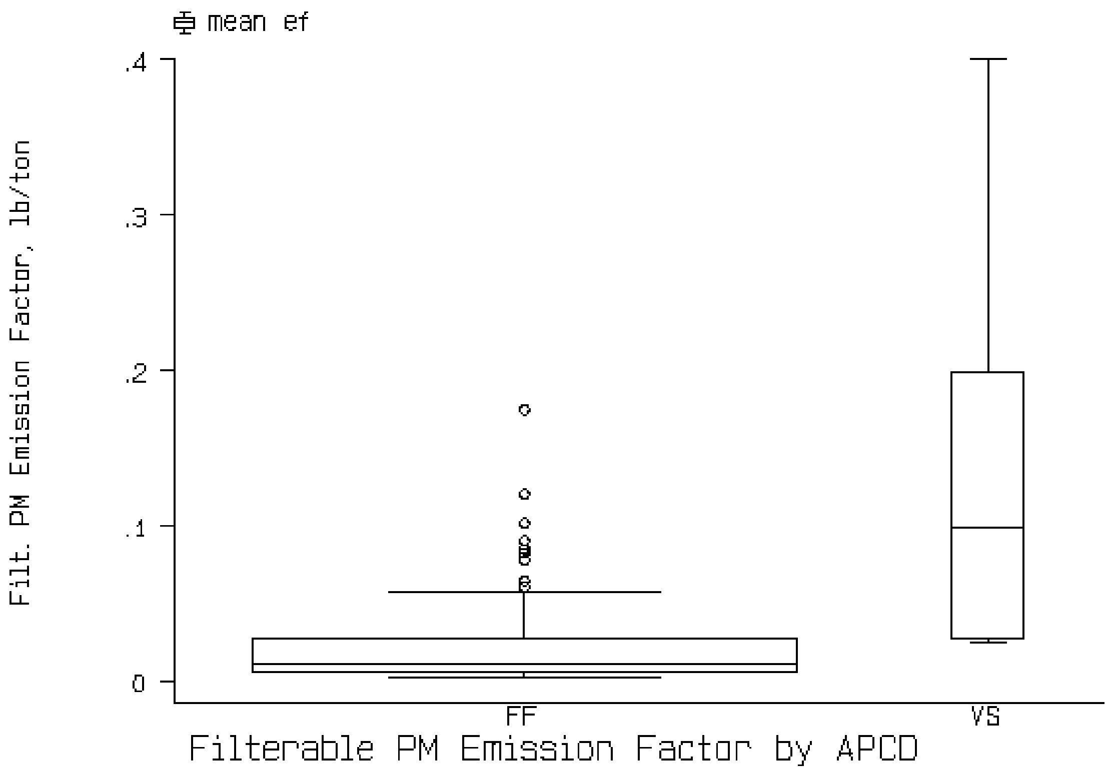

Figure 4-2. Boxplot of filterable PM data by control device for batch mix plants.

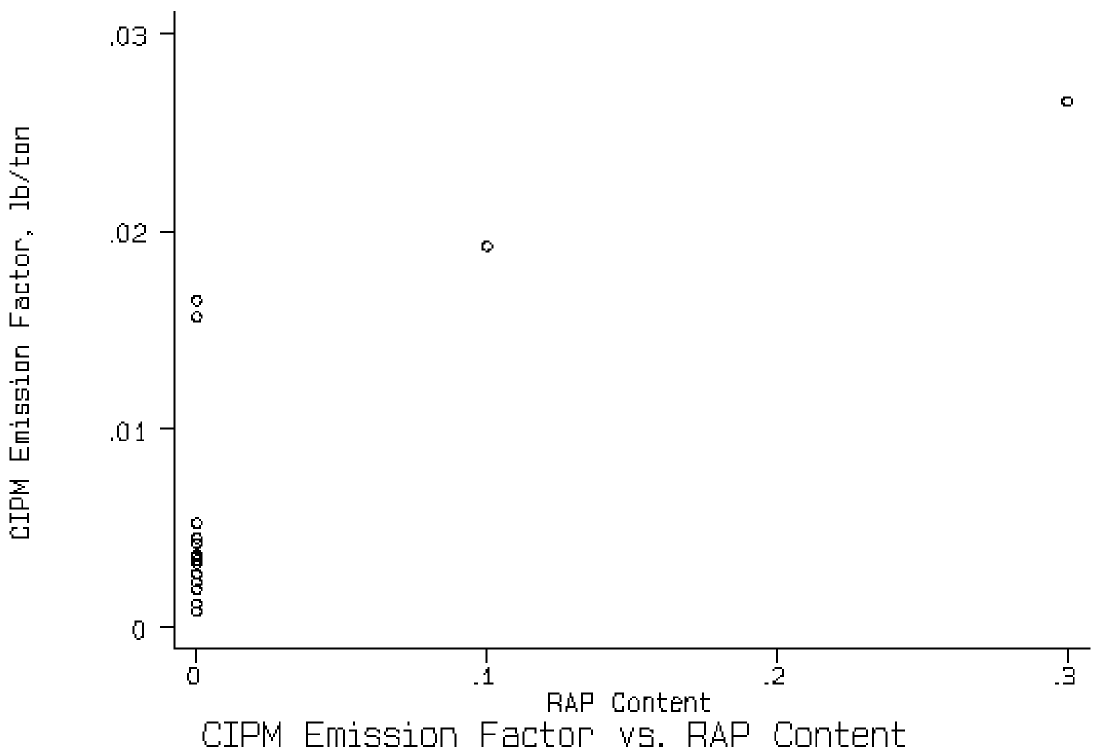

Figure 4-3. Plot of condensable inorganic PM emission factor versus RAP content for batch mix plants.

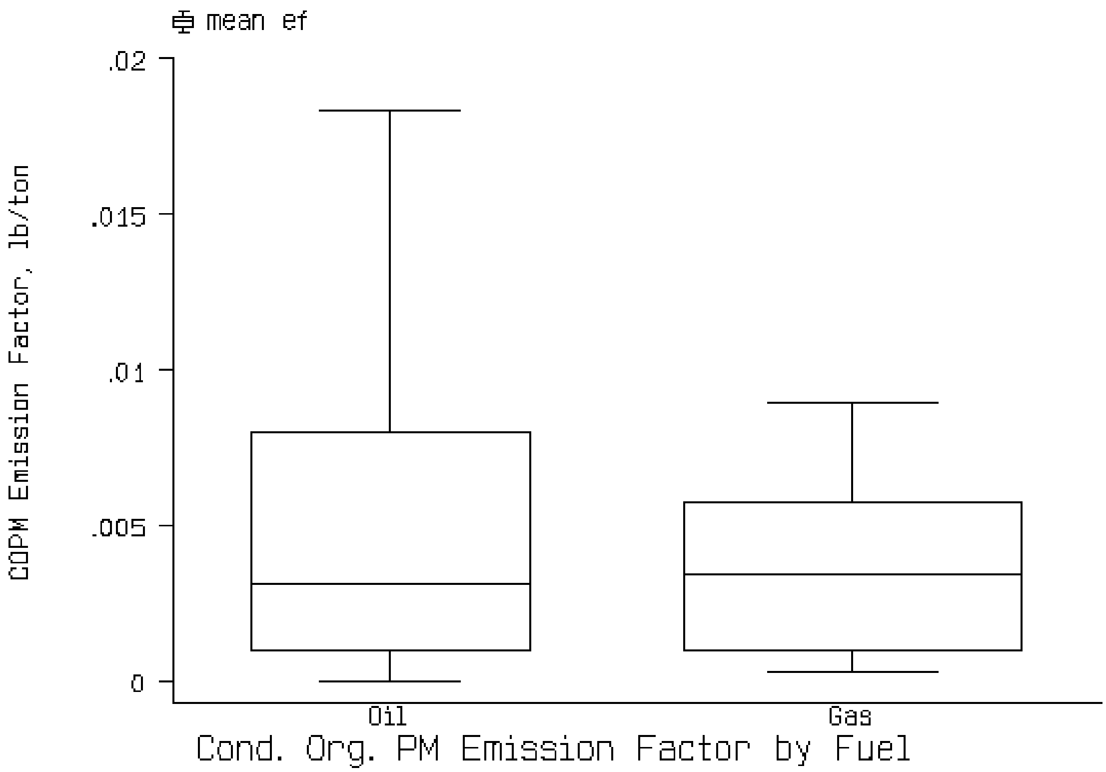

Figure 4-4. Boxplot of condensable organic PM data by fuel type for batch mix plants.

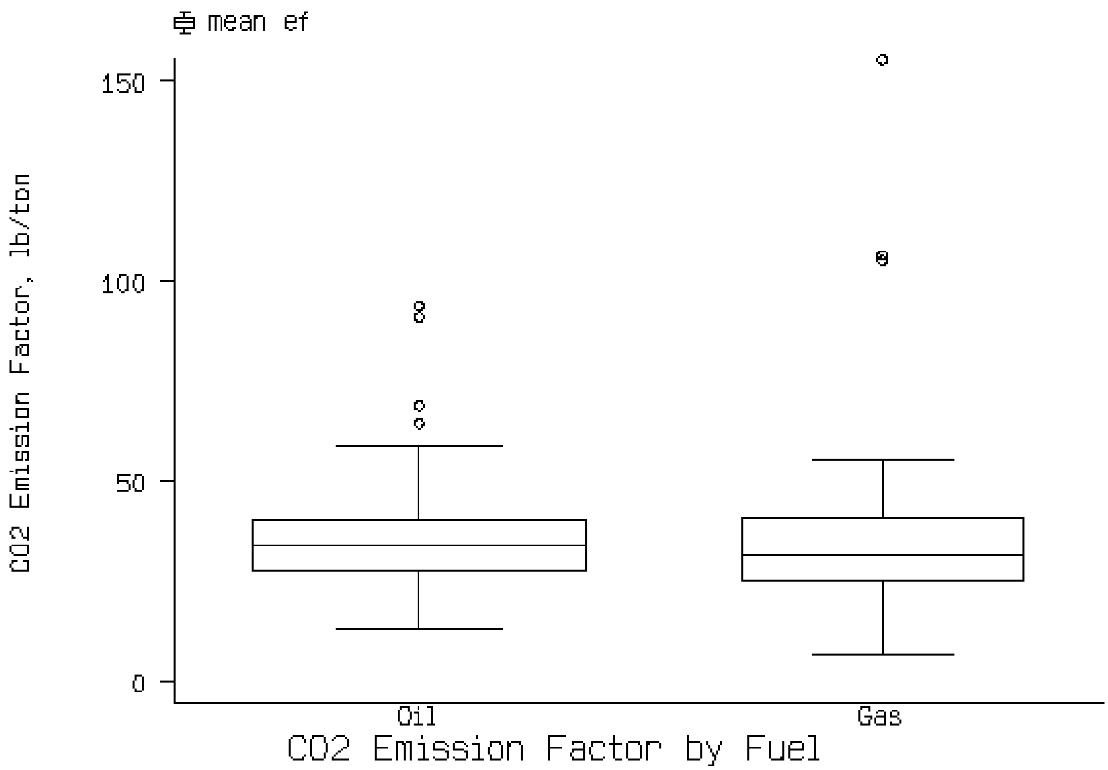

Figure 4-5. Boxplot of CO_2 data by fuel type for batch mix plants.

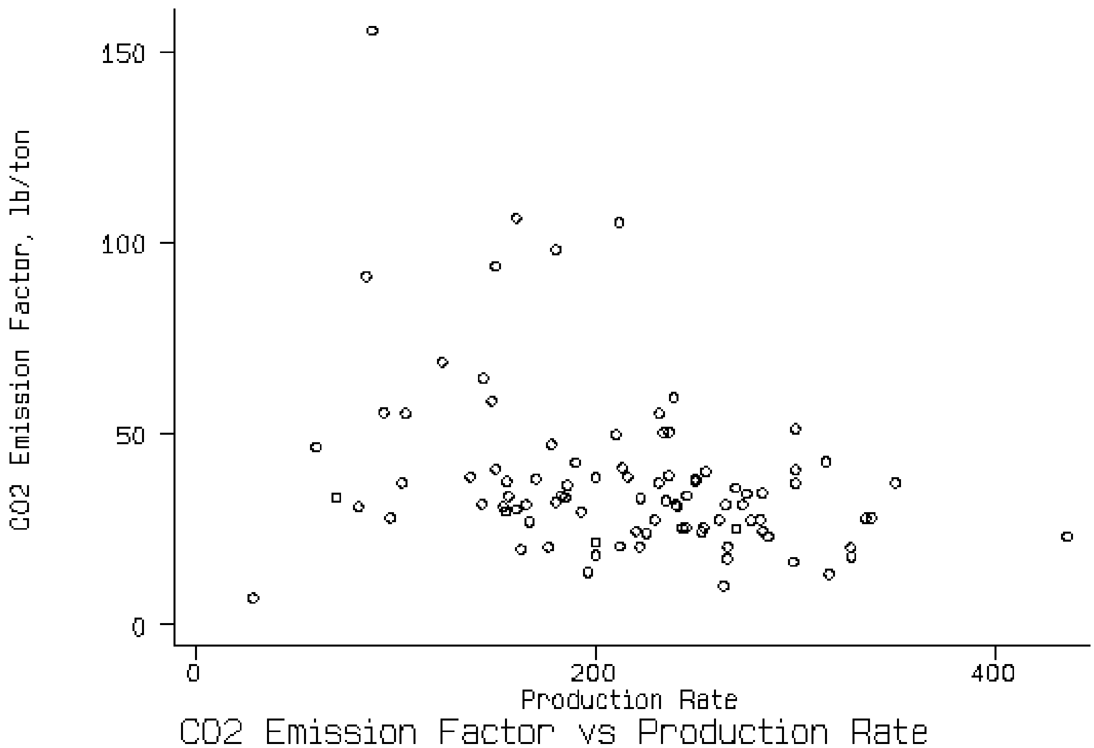

Figure 4-6. Plot of CO_2 emission factor by production rate for batch mix plants.

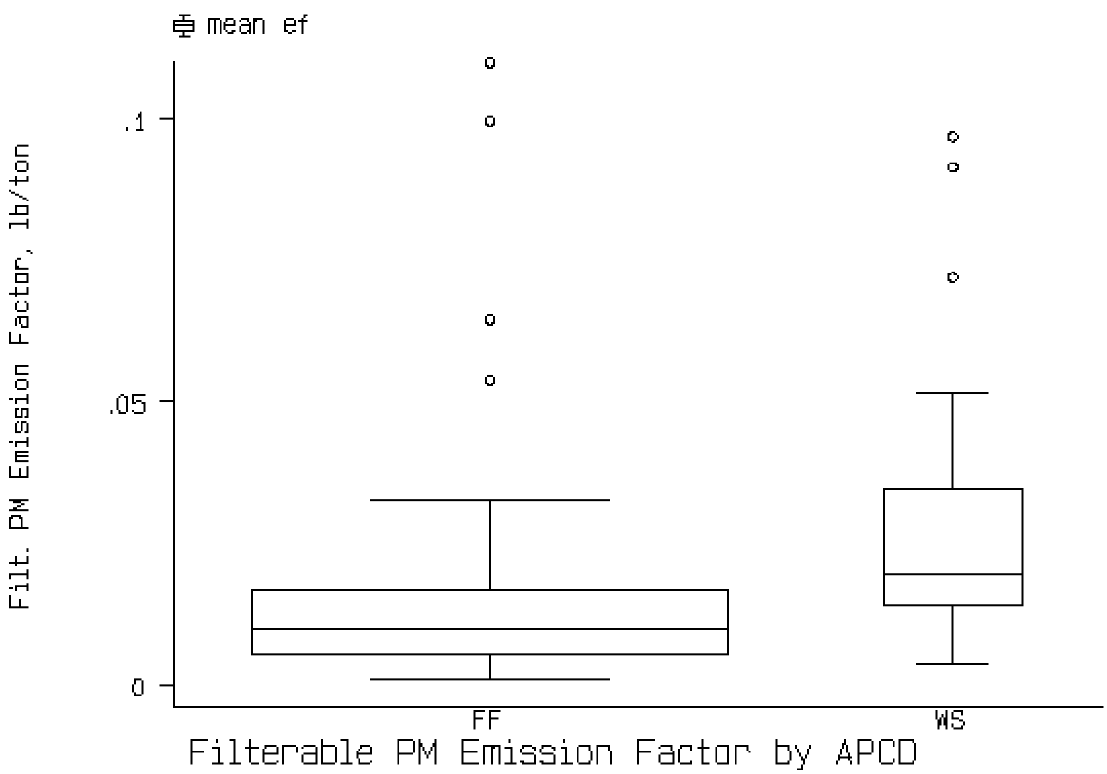

Figure 4-7. Boxplot of filterable PM data by control device for drum mix plants.

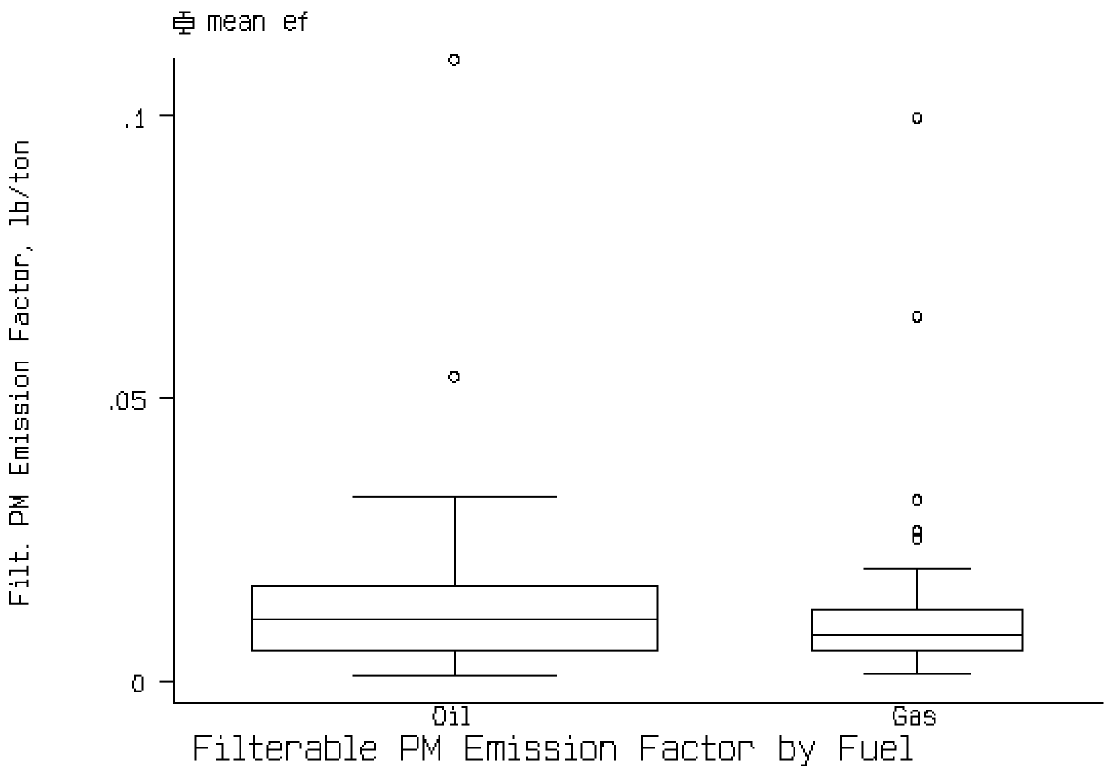

Figure 4-8. Boxplot of fabric filter-controlled filterable PM data by fuel type for drum mix plants.

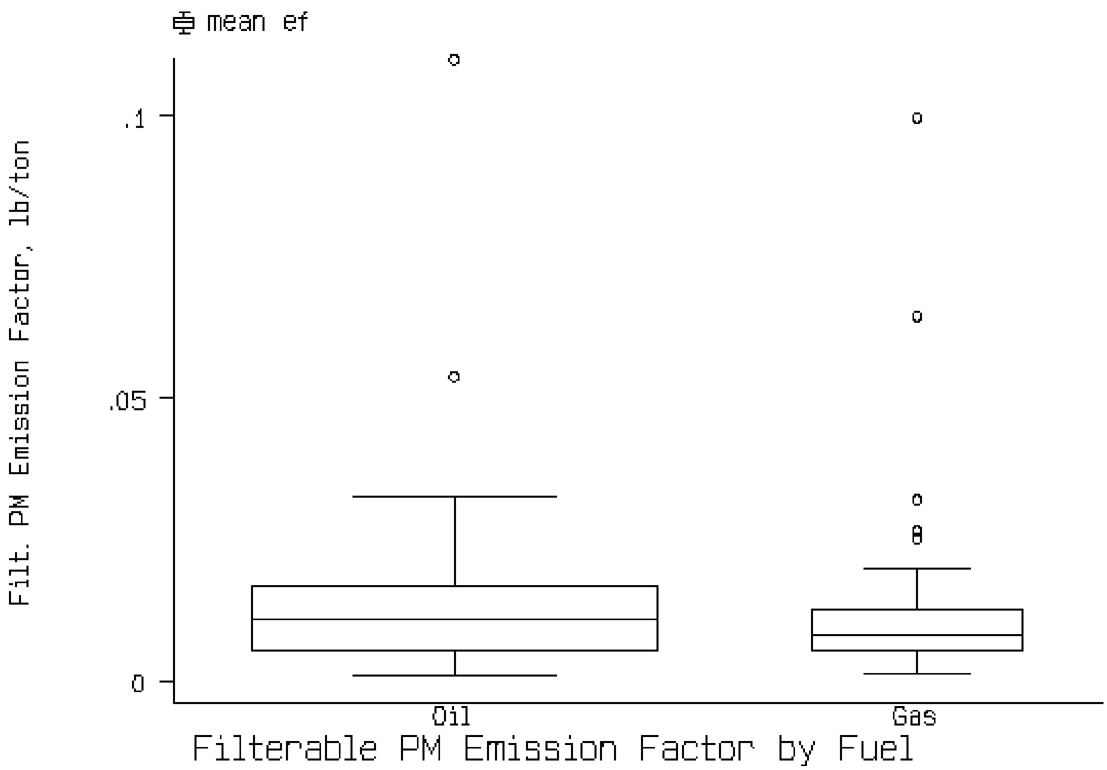

Figure 4-9. Boxplot of condensable organic PM data by fuel type for drum mix plants.

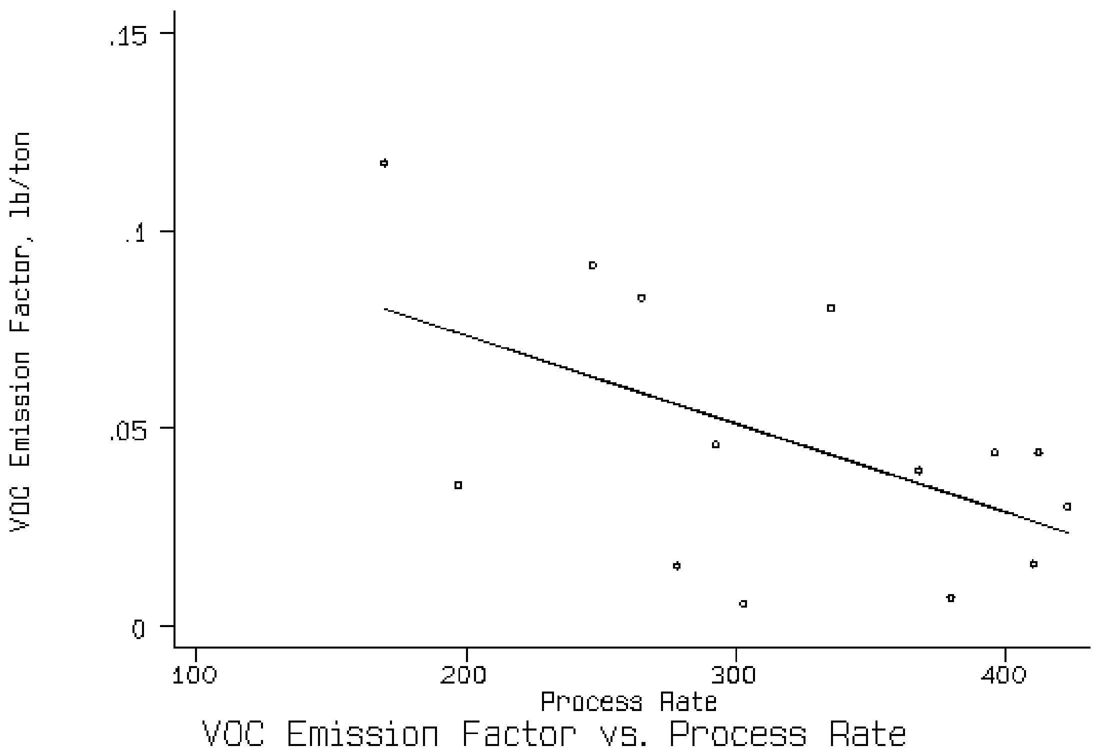

Figure 4-10. Plot of VOC emission factor versus production rate for drum mix plants.

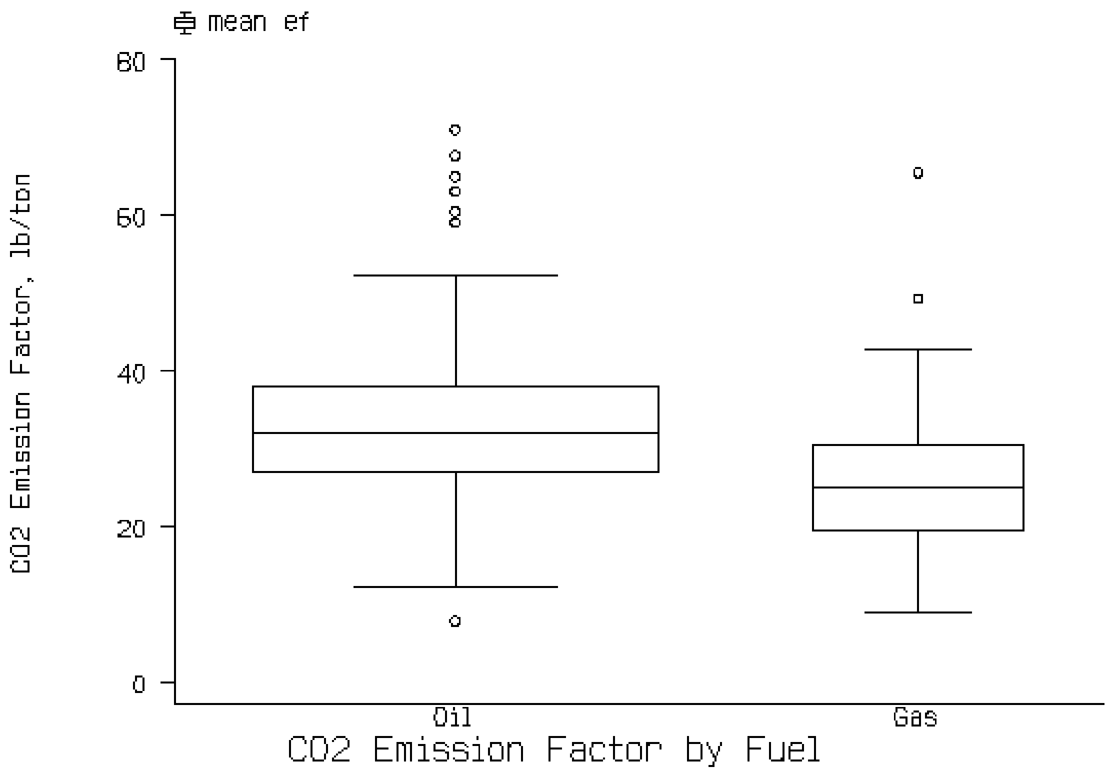

Figure 4-11. Boxplot of CO_2 data by fuel type for drum mix plants.

Asphalt Pavement Environmental Council Best Practices

Controlling Fumes, Emissions and Odors from HMA Plant and Paving Operations

AT THE PLANT

- Select plant mixing temperature by:
  — Contacting your asphalt supplier.
  — Using the chart on the back.
- Do not use laboratory mixing temperature as plant mixing temperature.
- Make sure RAP and aggregates are dry.
- Do not use RAP containing coal tar.
- Do not expose RAP to flame.
- Do not over-heat RAP.
- Look for other sources of fumes such as:
  — Slag aggregate
  — Shingles
  — Crumb rubber mixtures
  — Other products from construction and demolition waste.
- Read the Material Safety Data Sheet (MSDS) for all materials.
- Regularly calibrate thermocouples and other sensors.
- Tune up the burner.
- Contact the manufacturer and find out the limits on CO and O_2.
- When the stack is tested, compare the plant's thermocouple reading to the tester's thermocouple.
- Gather data on aggregate moisture content and fuel usage. If fuel usage goes up for the same or less moisture, find the reason.
- Have stack gases tested to see if they are in limits. If not, contact manufacturer to make adjustments.
- Compare mix temperatures with plant temperatures. Look for changes with time.
- Measure and record the pressure drop in the baghouse. Look for changes over time.
- Keep a record of fuel usage over time. Find the reason for any big changes.
- Keep track of this information and discuss it with co-workers and the manufacturer.
- Do not use diesel fuel and kerosene as release agents.

AT THE PAVING SITE

- Try increasing the mat lift thickness before calling for a higher plant temperature.
- Do not use diesel fuel and kerosene as release agents.
- Maintain engineering controls on paving equipment.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

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Figure 4-12. Asphalt Pavement Environmental Council, Best Practices Brochure, Side 1.

Asphalt Pavement Environmental Council Best Practices

Typical Asphalt Binder Temperatures

Binder Grade	HMA Plant Asphalt Tank Storage Temperature (°F)		HMA Plant Mixing Temperature (°F)	
	Range	Midpoint	Range	Midpoint
PG 46 -28	260 – 290	275	240 – 295	264
PG 46 -34	260 – 290	275	240 – 295	264
PG 46 -40	260 – 290	275	240 – 295	264
PG 52 -28	260 – 295	278	240 – 300	270
PG 52 -34	260 – 295	278	240 – 300	270
PG 52 -40	260 – 295	278	240 – 300	270
PG 52 -46	260 – 295	278	240 – 300	270
PG 58 -22	280 – 305	292	260 – 310	285
PG 58 -28	280 – 305	292	260 – 310	285
PG 58 -34	280 – 305	292	260 – 310	285
PG 64 -22	285 – 315	300	265 – 320	292
PG 64 -28	285 – 315	300	265 – 320	292
PG 64 -34	285 – 315	300	265 – 320	292
PG 67 -22	295 – 320	308	275 – 325	300
PG 70 -22	300 – 325	312	280 – 330	305
PG 70 -28	295 – 320	308	275 – 325	300
PG 76 -22	315 – 330	322	285 – 335	310
PG 76 -28	310 – 325	318	280 – 330	305
PG 82 -22	315 – 335	325	290 – 340	315

Use mid-point temperature for test strip construction.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

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Figure 4-13. Asphalt Pavement Environmental Council, Best Practices Brochure, Side 2.

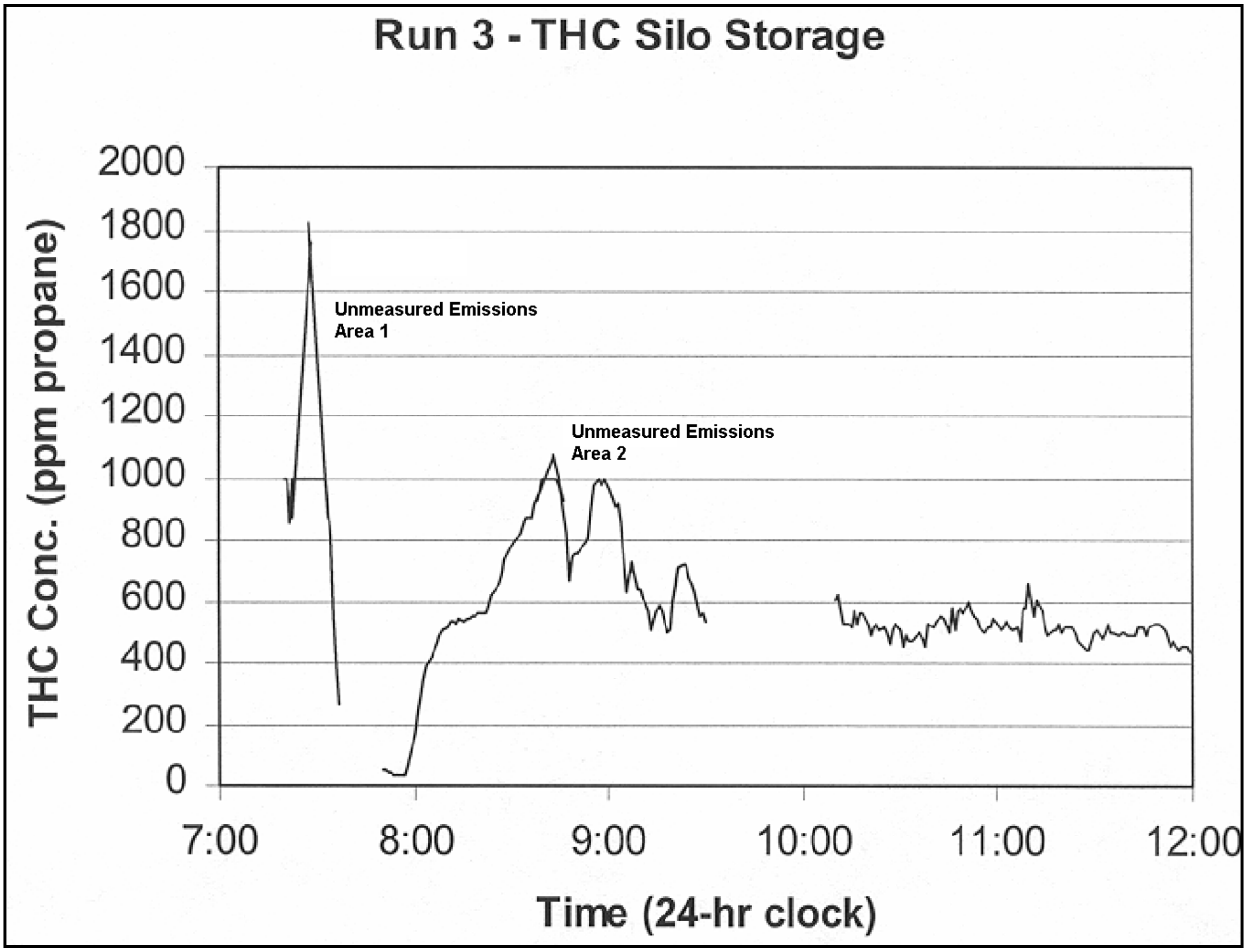

Figure 4-14. Unmeasured TOC silo storage emissions, Run 3.

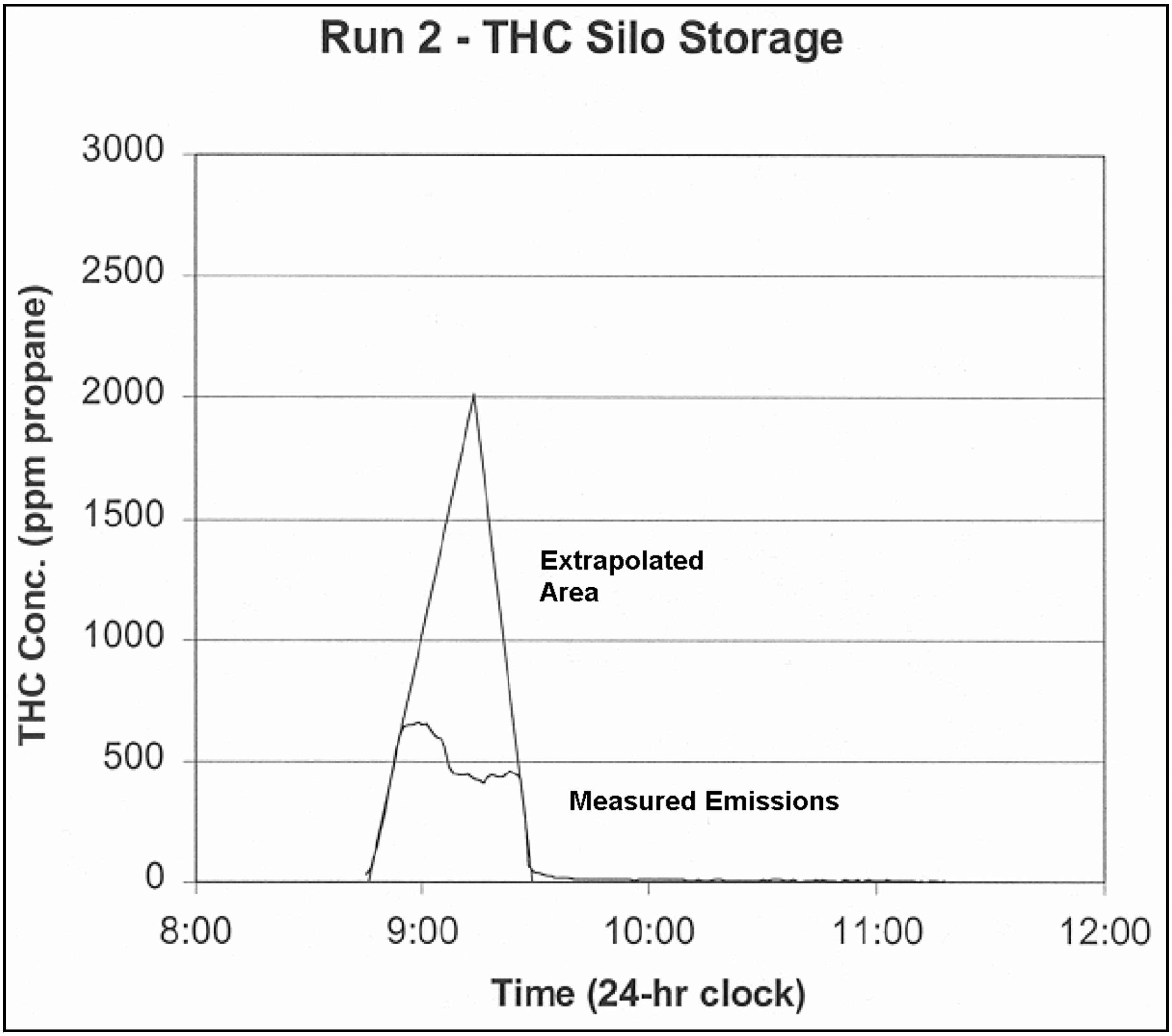

Figure 4-15. THC silo storage emissions, Run 2.

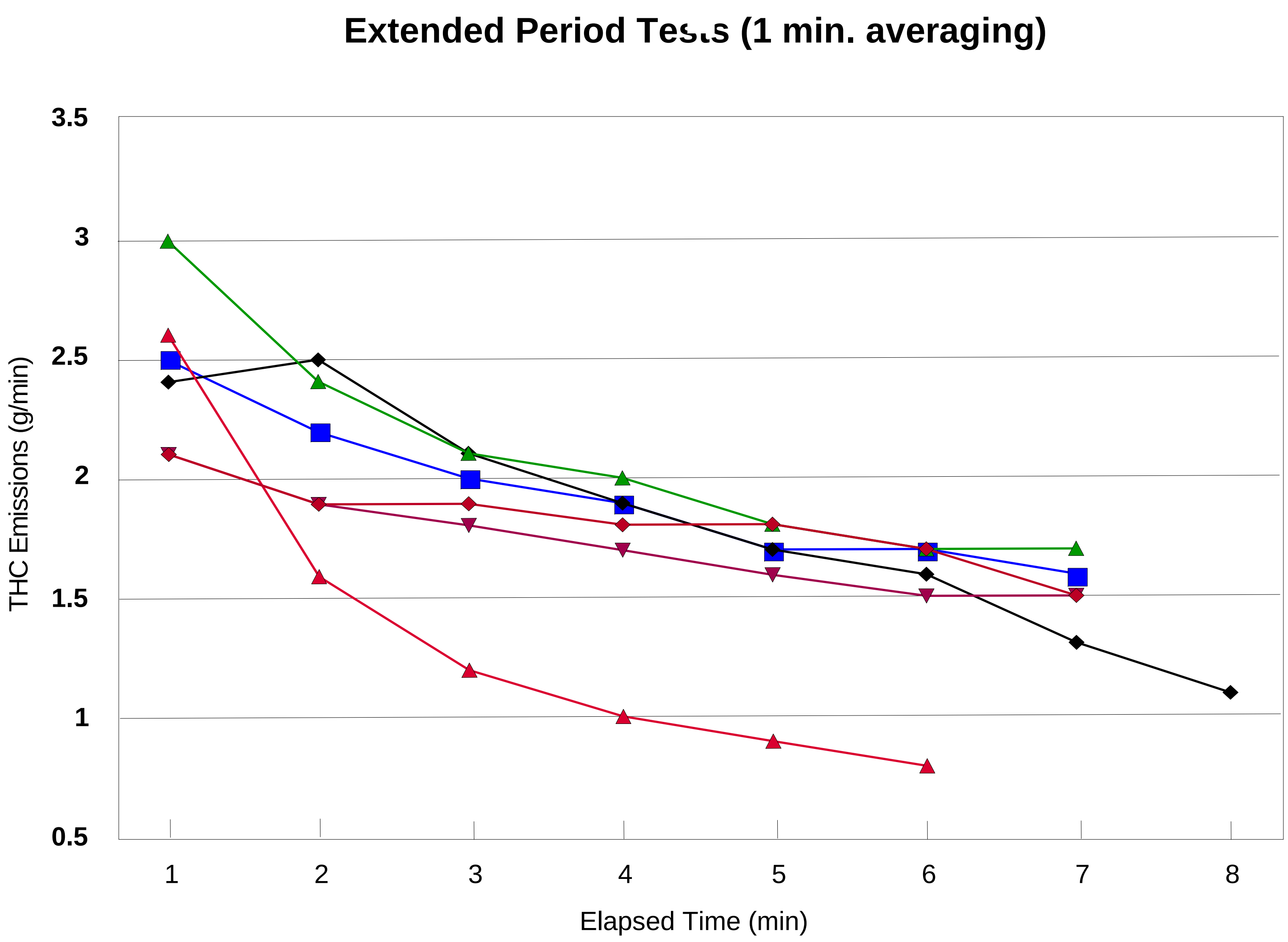

Figure 4-16. Extended period tests (1 min averaging).

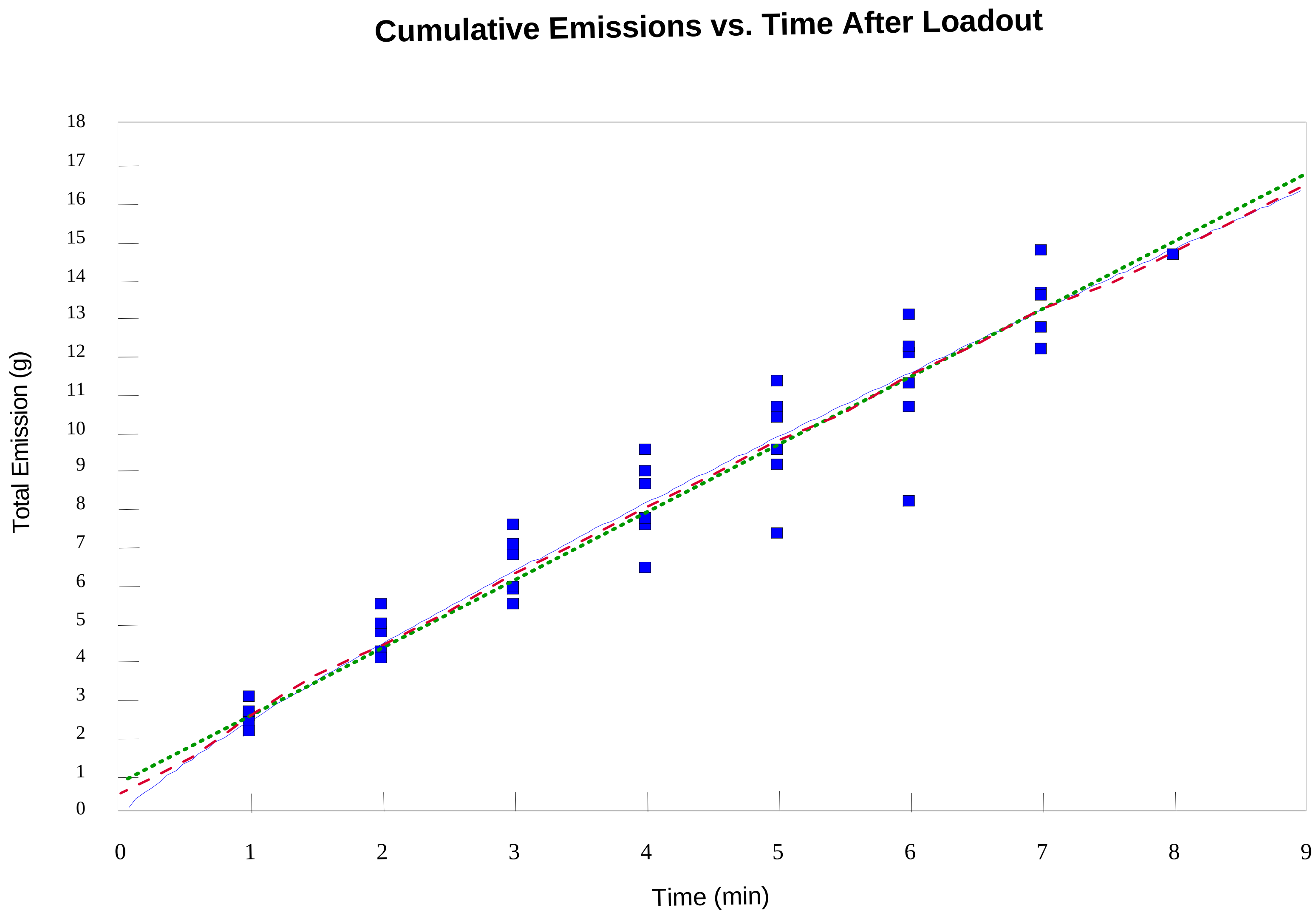

Figure 4-17. Cumulative emissions vs. time after load-out.

Table 4-1. REFERENCES NOT USED FOR EMISSION FACTOR DEVELOPMENT

Ref. No.	Reason for exclusion
42	Insufficient process description and production data
43	Insufficient process description and production data
115	No production data provided
116	Insufficient process description
120	Test methods not comparable to EPA reference methods
127	Insufficient process description
129	Incomplete report
131	Problems with test procedure
134	Insufficient process description
136	No production data provided
150	Flow rates not provided; cannot calculate emission rates
151	Flow rates not provided; cannot calculate emission rates
152	Flow rates not provided; cannot calculate emission rates
156	Flow rates not provided; cannot calculate emission rates
157	Flow rates not provided; cannot calculate emission rates
158	Flow rates not provided; cannot calculate emission rates
159	Flow rates not provided; cannot calculate emission rates
169	Insufficient test data provided
185	Stack conditions caused problems with test
194	Insufficient test data provided
207	Insufficient process description
208	Insufficient test data provided
227	Not a test report; miscellaneous data reported
228	Same test as Reference 226
230	Insufficient process description
272	Insufficient process description
305	Insufficient test data provided
357-369	Insufficient data to develop load-out emission factors

Table 4-2. ROLLING FILM THICKNESS LOSS-ON-HEATING DATA – PLANT C ASPHALT[a]

Temperature, °F	Date	Loss-on-heating, % by RTFOT[b]
300	07/24/98	–0.216
	07/25/98	–0.200
	07/27/98	–0.142
	07/28/98	–0.171
	07/24/98	–0.369
325	07/25/98	–0.311
	07/27/98	–0.286
	07/28/98	–0.292
	07/24/98	–0.686
350	07/25/98	–0.611
	07/27/98	–0.498
	07/28/98	–0.510

[a] Reference 355.
[b] RTFOT = Rolling thin film oven test, as specified in ASTM D2872-88, "Effects of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)."

Table 4-3. ROLLING FILM THICKNESS LOSS-ON-HEATING DATA – PLANT D ASPHALT D[a]

Temperature, °F	Date	Loss-on-heating, % by RTFOT[b]
300	10/05/98	–0.089
	10/06/98	–0.105
	10/07/98	–0.109
325	10/05/98	–0.216
	10/06/98	–0.206
	10/07/98	–0.218
350	10/05/98	–0.400
	10/06/98	–0.395
	10/07/98	–0.380

[a] Reference 356
[b] RTFOT = Rolling thin film oven test, as specified in ASTM D2872-88, "Effects of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)."

Table 4-4. SUMMARY OF SUMMA CANNISTER SAMPLE ANALYSES – REFERENCE 359

Sampling location	BTEX Compounds Detected	Concentration, ppbv	Other Pollutants Detected
Railcar hatch	Could not be quantified[a]	NA	Xylenes –hexane
Storage tank vent	Could not be quantified[a]	NA	Xylenes –Hexane, Hexane isomers
Upwind site	Benzene Toluene Ethyl benzene Total xylenes	<0.20 0.37 <0.20 1.57	Acetic acid Methyl ethyl ketone
Downwind site	Benzene Toluene Ethyl benzene Total xylenes	<0.20 0.30 <0.20 0.76	Acetic acid Methyl ethyl ketone
Residential site	Benzene Toluene Ethyl benzene Total xylenes	0.65 1.88 <0.20 0.52	Acetic acid Methyl ethyl ketone

[a] Beyond calibration range of instrument.

Table 4-5. SUMMARY OF PORTABLE GC/MS SAMPLE ANALYSES – REFERENCE 359

Sampling location	BTEX Compounds Detected	Concentration, ppmv
Railcar hatch	Benzene	1.2
	Toluene	2.5
	Ethyl benzene	1.9
	Total xylenes	3.1
Storage tank vent	Benzene	2.6
	Toluene	9.1
	Ethyl benzene	6.0
	Total xylenes	12.6
Upwind site	Benzene	<0.20
	Toluene	<0.20
	Ethyl benzene	0.04
	Total xylenes	<0.20
Downwind site	Benzene	<0.20
	Toluene	<0.20
	Ethyl benzene	0.04
	Total xylenes	<0.20
Residential site	Benzene	<0.20
	Toluene	<0.20
	Ethyl benzene	0.04
	Total xylenes	<0.20

Table 4-6. SUMMARY OF ORGANIC VAPOR ANALYZER SAMPLE ANALYSES – REFERENCE 359

Sampling location	Concentration, ppmv
Railcar hatch	600
Storage tank vent	200 to 500
Upwind site	1.3
Downwind site	1.2
Residential site	1.2

Table 4-7. SUMMARY OF SAMPLE ANALYSIS – REFERENCE 360

Sample	Benzene Concentration, ppbv
RC02	<0.1
RC03	<0.1
RC04	<0.1
RC05	3.33
RC06	509
AC01	<0.1
AC02	<0.1
AC03	<0.1
AC04	<0.1
AC05	1.25
EB02	67.3
EB03	.515
EB04	4.19
EB05	0.678
EB06	<0.1
SW01	0.195
SW02	<0.1
SW03	<0.1
SW04	<0.1
SW05	1.734
WY01	2.625
WY02	6.657
WY03	5.005
WY04	2.222
WY05	1.252

Table 4-8. SUMMARY OF SAMPLE ANALYSIS – REFERENCE 361

Pollutant	Emission Rate, ug/m^2-min	
	Asphalt without Rubber	Asphalt with Rubber
Benzene	57	110
2-Methyl phenol	7.2	23.7
Diethyl phthalate	32.7	34.37
bis (2-ethylhexyl) Phthalate	5.1	5.3
Naphthalene	0.103	0.063
Fluoranthene	1.648	1.178
Pyrene	1.469	1.612
Benzo(a)anthracene	0.786	0.653
Chrysene	4.42	1.957
Benzo(k)fluoranthene	1.106	0.306
Benzo(a)pyrene	0.660	0.204
Indeno(1,2,3-c.d)pyrene	0.141	0.065
Lead	0.542	1.10
PM-10 (organic train)	26,850	12,710
PM-10 (metals train)	37,710	19,810
Total PM (organic train)	27,700	12,950

Table 4-9. SUMMARY OF CEMS DATA – REFERENCE 361

Pollutant	Emission rate, mg/m^2-min		
	Facility blank	Asphalt without rubber	Asphalt with rubber
CO	171	144	201
CO_2	8,650	9,616	8,053
NO	32.1	5.4	17.2
TOC	126.3	91.1	124.3
SO_2	0.01	0.00	0.52
PAH	7	61	11

Table 4-10. SUMMARY OF POLLUTANTS NOT DETECTED

DRYERS			
Pollutant	Ref. No.	Pollutant	Ref. No.
Sulfur dioxide[a]	24	Fluoranthene[a]	24,50
Antimony	24,25	Fluorene[a]	24
Arsenic[a]	24,162-164	Indeno(1,2,3-cd)pyrene[a]	24,34,35,46
Beryllium[a]	24,25,35,162-164	Perylene[a]	24
Phosphorus[a]	24	Phenanthrene[a]	24
Selenium[a]	24,25,35,162-164	Pyrene[a]	24
Thallium	24,25	o-Tolualdehyde	24,25
Acenaphthylene[a]	24	Acrolein[a]	24
Acenaphthene[a]	24,47	2,5-Dimethylbenzaldehyde	24,25
Anthracene[a]	24,45	Isophorone	24,25
Benzo(a)anthracene[a]	24,34,35	Isovaleraldehyde[a]	24
Benzo(a)pyrene[a]	24,34,35	p-Tolualdehyde	24,25
Benzo(b)fluoranthene[a]	24	m-Tolualdehyde	24,25
Benzo(e)pyrene[a]	24	Xylene[a]	34,35,45,47-50
Benzo(g,h,i)perylene[a]	24,34,35	Methyl Chloroform[a]	34
Benzo(k)fluoranthene[a]	24,34,46	Hydrogen Sulfide	34,35
2-Chloronaphthalene	24,48	Chromium[a]	35
Chrysene[a]	24,34	Hexavalent Chromium[a]	35,162,164
Dibenz(a,h)anthracene[a]	24,34,35,46,48	Copper[a]	35
Dibenzofurans[a]	24	Nickel[a]	35,162
7,12-Dimethylbenz(a)anthracene	24	Benzene[a]	35,47-50
Toluene[a]	45,47-50	Ethylbenzene[a]	45,47-50
Methane	48	Cadmium	163,164
Lead	163,318,319		
HOT OIL HEATERS			
Benzo(a)anthracene	35	2,3,4,6,7,8-HxCDF	35
Chrysene	35	1,2,3,7,8,9-HxCDF	35
Benzo(k)fluoranthene	35	1,2,3,4,7,8,9-HpCDF	35
Benzo(a)pyrene	35	TCDDs (total)	35
Dibenz(a,h)anthracene	35	2,3,7,8-TCDD	35
Benzo(g,h,i)perylene	35	PeCDDs (total)	35
Indeno(1,2,3-cd)pyrene	35	1,2,3,7,8-PeCDD	35
2,3,7,8-TCDF	35	1,2,3,6,7,8-HxCDD	35
2,3,4,7,8-PeCDF	35	Benzene	35
1,2,3,4,7,8-HxCDF	35		

[a] Pollutant was detected in at least one other test referenced. Table does not include non-detect compounds from references beyond Reference 338.

Table 4-11. SUMMARY OF TEST DATA FOR HOT MIX ASPHALT PLANTS; DRUM MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	ND	ND	Total PM	ND	D	1.8-3.1 (3.6-6.2)	2.5 (4.9)	11
Cyclone or multiclone	ND	ND	Total PM	ND	D	0.25-0.43 (0.49-0.85)	0.34 (0.67)	11
Wet scrubber	ND	ND	Total PM	ND	D	0.025-0.045 (0.050-0.090)	0.035 (0.070)	11
Venturi scrubber	ND	ND	Total PM	ND	D	0.015-0.030 (0.030-0.060)	0.023 (0.045)	11
Fabric filter[b] (Plant A)	No. 2 fuel oil	ND	TNMOC	2	D	0.085-0.12 (0.17-0.24)	0.11 (0.21)	22
Fabric filter[b] (Plant A)	Natural gas	ND	TNMOC	1	NR	0.11 (0.22)	0.11 (0.22)	22
Fabric filter (Plant A)	No. 2 fuel oil, natural gas	ND	Filterable PM	3	C	0.090-0.13 (0.18-0.25)	0.11 (0.21)	22
Fabric filter[b] (Plant B)	Propane	ND	TNMOC	5	D	0.021-0.055 (0.041-0.11)	0.033 (0.066)	22
Fabric filter[b] (Plant C)	No. 4 fuel oil	ND	TNMOC	4	D	0.042-0.060 (0.083-0.12)	0.050 (0.10)	22
Fabric filter (Plant D)	Natural gas	0 to 30	TNMOC	5	D	0.13-0.22 (0.25-0.44)	0.16 (0.33)	22
None (Plant E)	Natural gas	ND	TNMOC	3	D	0.080-0.30 (0.16-0.59)	0.16 (0.31)	22
Venturi scrubber (Plant E)	Natural gas	ND	TNMOC	5	D	0.065-0.095 (0.13-0.19)	0.080 (0.16)	22
Fabric filter	Waste oil	30	Filterable PM	6	A	0.0048-0.0099 (0.0097-0.020)	0.0079 (0.016)	25
Fabric filter	Waste oil	30	Filterable PM-10	3	A	0.0023-0.0030 (0.0046-0.0060)	0.0026 (0.0052)	25
Fabric filter	Waste oil	30	Cond. inorganic PM	3	A	0.0097-0.018 (0.019-0.036)	0.014 (0.027)	25
Fabric filter	Waste oil	30	Cond. organic PM	3	A	0.0011-0.0023 (0.0022-0.0046)	0.0016 (0.0032)	25
Fabric filter[b]	Waste oil	30	TOC as propane	10	A	0.037-0.060 (0.073-0.12)	0.046 (0.091)	25
Fabric filter[b]	Waste oil	30	SO_2	10	A	0.034-0.055 (0.068-0.11)	0.049 (0.098)	25

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	Waste oil	30	NO_x	10	A	0.025-0.040 (0.050-0.080)	0.034 (0.068)	25
Fabric filter[b]	Waste oil	30	CO_2	9	A	16-23 (31-46)	19 (38)	25
Fabric filter[b]	Waste oil	30	CO	10	A	0.0046-0.079 (0.0092-0.16)	0.019 (0.038)	25
Fabric filter	Waste oil	30	Arsenic	3	A	$4.9x10^{-7}$-$1.6x10^{-6}$ ($9.7x10^{-7}$-$3.1x10^{-6}$)	$9.5x10^{-7}$ ($1.9x10^{-6}$)	25
Fabric filter	Waste oil	30	Barium	3	A	$2.0x10^{-7}$-$5.5x10^{-6}$ ($3.9x10^{-7}$-$9.9x10^{-6}$)	$2.4x10^{-6}$ ($4.8x10^{-6}$)	25
Fabric filter	Waste oil	30	Cadmium	3	A	$1.4x10^{-7}$-$5.5x10^{-7}$ ($2.7x10^{-7}$-$9.9x10^{-7}$)	$3.1x10^{-7}$ ($6.2x10^{-7}$)	25
Fabric filter	Waste oil	30	Chromium	3	A	$6.5x10^{-7}$-$9.5x10^{-6}$ ($1.3x10^{-6}$-$1.9x10^{-5}$)	$6.0x10^{-6}$ ($1.2x10^{-5}$)	25
Fabric filter	Waste oil	30	Copper	3	A	$2.2x10^{-6}$-$4.8x10^{-6}$ ($4.3x10^{-6}$-$9.5x10^{-6}$)	$3.1x10^{-6}$ ($6.1x10^{-6}$)	25
Fabric filter	Waste oil	30	Lead	3	A	$2.4x10^{-6}$-$4.1x10^{-6}$ ($4.7x10^{-6}$-$8.1x10^{-6}$)	$3.0x10^{-6}$ ($6.0x10^{-6}$)	25
Fabric filter	Waste oil	30	Manganese	3	A	$2.8x10^{-6}$-$7.0x10^{-6}$ ($5.6x10^{-6}$-$1.4x10^{-5}$)	$5.5x10^{-6}$ ($1.1x10^{-5}$)	25
Fabric filter	Waste oil	30	Nickel	3	A	$2.8x10^{-7}$-$1.3x10^{-5}$ ($5.6x10^{-7}$-$2.5x10^{-5}$)	$7.5x10^{-6}$ ($1.5x10^{-5}$)	25
Fabric filter	Waste oil	30	Phosphorus	3	A	$2.2x10^{-5}$-$3.7x10^{-5}$ ($4.4x10^{-5}$-$7.3x10^{-5}$)	$2.8x10^{-5}$ ($5.5x10^{-5}$)	25
Fabric filter	Waste oil	30	Silver	3	A	$5.5x10^{-7}$-$8.5x10^{-7}$ ($1.1x10^{-6}$-$1.7x10^{-6}$)	$7.0x10^{-7}$ ($1.4x10^{-6}$)	25
Fabric filter	Waste oil	30	Zinc	3	A	$2.0x10^{-5}$-$3.5x10^{-5}$ ($3.9x10^{-5}$-$6.9x10^{-5}$)	$2.7x10^{-5}$ ($5.3x10^{-5}$)	25
Fabric filter	Waste oil	30	Naphthalene	3	A	0.00018-0.00032 (0.00036-0.00063)	0.00024 (0.00047)	25
Fabric filter[b]	Waste oil	30	Acetaldehyde	4	A	0.00028-0.0013 (0.00055-0.0025)	0.00065 (0.0013)	25
Fabric filter[b]	Waste oil	30	Acetone	4	A	0.00026-0.00055 (0.00052-0.0011)	0.00042 (0.00083)	25
Fabric filter[b]	Waste oil	30	Acrolein	4	A	$1.4x10^{-6}$-$3.3x10^{-5}$ ($2.8x10^{-6}$-$6.6x10^{-5}$)	$1.3x10^{-5}$ ($2.6x10^{-5}$)	25
Fabric filter[b]	Waste oil	30	Benzaldehyde	4	A	$1.3x10^{-5}$-$1.7x10^{-4}$ ($2.5x10^{-5}$-$3.3x10^{-4}$)	$5.5x10^{-5}$ (0.00011)	25
Fabric filter[b]	Waste oil	30	Butyraldehyde/ Isobutyraldehyde	4	A	$5.5x10^{-5}$-$1.4x10^{-4}$ (0.00011-0.00027)	$8.0x10^{-5}$ (0.00016)	25
Fabric filter[b]	Waste oil	30	Crotonaldehyde	4	A	$1.1x10^{-5}$-$1.2x10^{-4}$ ($2.2x10^{-5}$-$2.4x10^{-4}$)	$4.3x10^{-5}$ ($8.6x10^{-5}$)	25
Fabric filter[b]	Waste oil	30	Formaldehyde	4	A	0.00030-0.0026 (0.00060-0.0051)	0.0010 (0.0020)	25
Fabric filter[b]	Waste oil	30	Hexanal	4	A	$2.8x10^{-5}$-$1.1x10^{-4}$ ($5.5x10^{-5}$-$2.2x10^{-4}$)	$5.5x10^{-5}$ (0.00011)	25

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	Waste oil	30	Isovaleraldehyde	4	A	2.0×10^{-6}-3.0×10^{-5} (4.1×10^{-6}-6.0×10^{-5})	1.6×10^{-5} (3.2×10^{-5})	25
Fabric filter[b]	Waste oil	30	Methyl Ethyl Ketone	4	B	1.8×10^{-6}-2.8×10^{-5} (3.5×10^{-6}-5.6×10^{-5})	1.0×10^{-5} (2.0×10^{-5})	25
Fabric filter[b]	Waste oil	30	Propionaldehyde	4	A	2.4×10^{-5}-1.7×10^{-4} (4.7×10^{-5}-3.3×10^{-4})	6.5×10^{-5} (0.00013)	25
Fabric filter[b]	Waste oil	30	Quinone	4	A	1.8×10^{-5}-1.8×10^{-4} (3.5×10^{-5}-3.5×10^{-4})	8.0×10^{-5} (0.00016)	25
Fabric filter[b]	Waste oil	30	Valeraldehyde	4	A	1.3×10^{-5}-7.5×10^{-5} (2.6×10^{-5}-1.5×10^{-4})	3.4×10^{-5} (6.7×10^{-5})	25
Fabric filter[b]	Waste oil	30	Methane	19	B	0.00036-0.12 (0.00072-0.23)	0.012 (0.025)	25
Fabric filter[b]	Waste oil	30	Benzene	19	B	2.5×10^{-5}-4.1×10^{-4} (4.9×10^{-5}-8.1×10^{-4})	0.00020 (0.00041)	25
Fabric filter[b]	Waste oil	30	Toluene	19	B	2.4×10^{-5}-8.9×10^{-4} (4.7×10^{-5}-1.8×10^{-3})	0.00037 (0.00075)	25
Fabric filter[b]	Waste oil	30	Ethylbenzene	19	B	1.1×10^{-6}-1.2×10^{-3} (2.1×10^{-6}-2.3×10^{-3})	0.00019 (0.00038)	25
Fabric filter[b]	Waste oil	30	Xylene	19	B	3.9×10^{-5}-1.2×10^{-3} (7.9×10^{-5}-2.3×10^{-3})	8.2×10^{-5} (1.6×10^{-4})	25
Fabric filter[b]	No. 2 fuel oil	0	CO_2	3	B	15-22 (30-43)	19 (37)	26
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0085-0.017 (0.017-0.033)	0.014 (0.027)	26
Fabric filter[b]	No. 2 fuel oil	0	CO_2	3	A	14-17 (27-35)	15 (30)	27
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0055-0.013 (0.011-0.027)	0.0085 (0.017)	27
Fabric filter[b]	ND	0	CO_2	3	B	17-18 (33-36)	17 (34)	28
Fabric filter	ND	0	Filterable PM	3	B	0.0010-0.0035 (0.0020-0.0070)	0.0022 (0.0043)	28
Fabric filter	ND	0	Cond. inorganic PM	3	B	0.0075-0.0085 (0.015-0.017)	0.0080 (0.016)	28
Venturi scrubber[b]	No. 2 fuel oil	0	CO_2	3	B	14-17 (28-33)	16 (31)	29
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	B	0.0055-0.012 (0.011-0.023)	0.0080 (0.016)	29
Fabric filter[b]	Natural gas	0	CO_2	3	A	9.6-9.8 (19-20)	9.6 (19)	30
Fabric filter	Natural gas	0	Filterable PM	3	A	0.013-0.015 (0.025-0.029)	0.014 (0.027)	30
None	No. 5 fuel oil	0	Filterable PM	2	B	20-30 (41-60)	25 (50)	31
Fabric filter	No. 5 fuel oil	0	Filterable PM	3	A	0.0035-0.012 (0.0068-0.024)	0.0088 (0.018)	31

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	No. 5 fuel oil	50	Filterable PM	3	A	2.2-3.4 (4.3-6.7)	2.7 (5.4)	31
Fabric filter	No. 5 fuel oil	50	Filterable PM	2	B	0.0024-0.0025 (0.0047-0.0051)	0.0025 (0.0049)	31
Scrubber[b]	No. 2 fuel oil	0	CO_2	3	B	19 (37-39)	19 (38)	32
Scrubber	No. 2 fuel oil	0	Filterable PM	3	B	0.008-0.015 (0.016-0.031)	0.012 (0.024)	32
Fabric filter[b]	No. 2 fuel oil	33	CO_2	3	A	7.8-16 (16-32)	11 (22)	33
Fabric filter	No. 2 fuel oil	33	Filterable PM	3	A	0.010-0.013 (0.020-0.025)	0.012 (0.023)	33
Fabric filter	Propane	ND[d]	Acenaphthene	3	B	$2.2x10^{-7}$-$3.8x10^{-7}$ ($4.4x10^{-7}$-$7.6x10^{-7}$)	$2.9x10^{-7}$ ($5.7x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Acenaphthylene	3	B	$3.7x10^{-8}$-$7.0x10^{-8}$ ($7.4x10^{-8}$-$1.4x10^{-7}$)	$5.0x10^{-8}$ ($1.0x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Anthracene	3	B	$2.2x10^{-8}$-$5.5x10^{-8}$ ($4.4x10^{-8}$-$1.1x10^{-7}$)	$3.7x10^{-8}$ ($7.3x10^{-8}$)	35
Fabric filter	Propane	ND[d]	Chrysene	3	C	$2.2x10^{-9}$-$3.5x10^{-9}$ ($4.4x10^{-9}$-$7.0x10^{-9}$)	$2.7x10^{-9}$ ($5.4x10^{-9}$)	35
Fabric filter	Propane	ND[d]	Fluorene	3	B	$3.2x10^{-7}$-$5.5x10^{-7}$ ($6.3x10^{-7}$-$1.1x10^{-6}$)	$4.1x10^{-7}$ ($8.1x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Naphthalene	3	B	$5.5x10^{-6}$-$7.5x10^{-6}$ ($1.1x10^{-5}$-$1.5x10^{-5}$)	$6.0x10^{-6}$ ($1.2x10^{-5}$)	35
Fabric filter	Propane	ND[d]	Phenanthrene	3	B	$6.5x10^{-7}$-$3.7x10^{-6}$ ($1.3x10^{-6}$-$7.4x10^{-6}$)	$1.8x10^{-6}$ ($3.6x10^{-6}$)	35
Fabric filter	Propane	ND[d]	Fluoranthene	3	B	$3.9x10^{-9}$-$1.7x10^{-8}$ ($7.8x10^{-9}$-$3.4x10^{-8}$)	$8.5x10^{-9}$ ($1.7x10^{-8}$)	35
Fabric filter	Propane	ND[d]	Pyrene	3	B	$7.0x10^{-9}$-$2.8x10^{-8}$ ($1.4x10^{-8}$-$5.5x10^{-8}$)	$1.5x10^{-8}$ ($2.9x10^{-8}$)	35
Fabric filter	Propane	ND[d]	Benzo(b)fluoranthene	3	B	$2.9x10^{-9}$-$4.8x10^{-8}$ ($5.7x10^{-9}$-$9.5x10^{-8}$)	$2.8x10^{-8}$ ($5.6x10^{-8}$)	35
Fabric filter	Propane	ND[d]	Benzo(k)fluoranthene	3	C	$8.0x10^{-10}$-$3.5x10^{-8}$ ($1.6x10^{-9}$-$7.0x10^{-8}$)	$1.4x10^{-8}$ ($2.7x10^{-8}$)	35
Fabric filter[b]	Propane	ND[d]	Formaldehyde	3	B	$3.9x10^{-5}$-$5.5x10^{-4}$ ($7.8x10^{-5}$-$1.1x10^{-3}$)	0.00034 (0.00067)	35
Fabric filter	Propane	ND[d]	Arsenic	3	B	$1.2x10^{-7}$-$1.4x10^{-7}$ ($2.3x10^{-7}$-$2.7x10^{-7}$)	$1.3x10^{-7}$ ($2.5x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Cadmium	3	B	$5.0x10^{-8}$-$2.8x10^{-7}$ ($9.9x10^{-8}$-$5.5x10^{-7}$)	$1.3x10^{-7}$ ($2.5x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Mercury	3	B	$9.0x10^{-10}$-$6.0x10^{-9}$ ($1.8x10^{-9}$-$1.2x10^{-8}$)	$3.7x10^{-9}$ ($7.3x10^{-9}$)	35
Fabric filter	Propane	ND[d]	Lead	3	B	$8.0x10^{-8}$-$7.0x10^{-7}$ ($1.6x10^{-7}$-$1.4x10^{-6}$)	$3.1x10^{-7}$ ($6.2x10^{-7}$)	35
Fabric filter	Propane	ND[d]	Zinc	3	B	$2.5x10^{-6}$-$4.1x10^{-5}$ ($5.1x10^{-6}$-$8.2x10^{-5}$)	$1.6x10^{-5}$ ($3.1x10^{-5}$)	35

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	Propane	ND[d]	Toluene	3	B	$1.4x10^{-5}$-$1.4x10^{-4}$ ($2.7x10^{-5}$-$2.7x10^{-4}$)	$8.5x10^{-5}$ (0.00017)	35
Fabric filter[b]	Propane	ND[d]	Methyl chloroform	3	C	$1.4x10^{-5}$-$4.4x10^{-5}$ ($2.7x10^{-5}$-$8.8x10^{-5}$)	$2.4x10^{-5}$ ($4.8x10^{-5}$)	35
None	Natural gas	ND[d]	Filterable PM	3	A	1.9-2.5 (3.7-4.9)	2.2 (4.4)	36
None	Natural gas	ND[d]	Cond. organic PM	3	A	0.018-0.022 (0.035-0.044)	0.021 (0.041)	36
Venturi scrubber	Natural gas	ND[d]	Filterable PM	3	A	0.040-0.055 (0.079-0.11)	0.049 (0.097)	36
Venturi scrubber	Natural gas	ND[d]	Cond. organic PM	3	A	0.007-0.010 (0.014-0.020)	0.0090 (0.018)	36
None	Natural gas	0	Filterable PM	3	A	1.4-1.9 (2.8-3.9)	1.6 (3.3)	37
None	Natural gas	0	Cond. organic PM	3	A	0.011-0.050 (0.022-0.10)	0.025 (0.050)	37
None	Natural gas	ND[d]	Filterable PM	3	A	0.90-1.0 (1.8-2.0)	0.97 (1.9)	37
None	Natural gas	ND[d]	Cond. organic PM	3	A	0.011-0.10 (0.022-0.20)	0.042 (0.083)	37
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0081-0.018 (0.016-0.035)	0.012 (0.025)	37
Venturi scrubber	Natural gas	0	Cond. organic PM	3	A	0.0084-0.012 (0.017-0.024)	0.010 (0.021)	37
Venturi scrubber	Natural gas	ND[d]	Filterable PM	3	A	0.0055-0.0073 (0.011-0.015)	0.0063 (0.013)	37
Venturi scrubber	Natural gas	ND[d]	Cond. organic PM	3	A	0.0047-0.016 (0.0094-0.032)	0.010 (0.020)	37
None	Natural gas	0	Filterable PM	6	B	14-21 (27-43)	17 (34)	38
None	Natural gas	10	Filterable PM	2	B	8.1-13 (16-25)	10 (21)	38
Fabric filter	Natural gas	15 – Run 1, 0--Run 2	Filterable PM	2	C	0.031-0.034 (0.061-0.068)	0.032 (0.064)	38
Fabric filter	Natural gas	30	Filterable PM	3	C	0.0071-0.0089 (0.014-0.018)	0.0077 (0.015)	40
Fabric filter[b]	Natural gas	30	Formaldehyde	3	D	0.0021-0.0025 (0.0043-0.0049)	0.0023 (0.0046)	40
Fabric filter	Waste oil	0	Filterable PM	3	C	0.00075-0.0014 (0.0015-0.0027)	0.00098 (0.0020)	40
Fabric filter[b]	Waste oil	0	Formaldehyde	3	D	0.00020-0.00024 (0.00040-0.00049)	0.00021 (0.00043)	40
Venturi scrubber	Waste oil	0	Filterable PM	3	C	0.015-0.016 (0.030-0.033)	0.016 (0.032)	40
Venturi scrubber	Waste oil	0	Formaldehyde	3	D	0.00015-0.00027 (0.00029-0.00054)	0.00021 (0.00041)	40

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Filterable PM	3	C	0.00055-0.00087 (0.0011-0.0017)	0.00067 (0.0013)	40
Fabric filter[b]	Natural gas	0	Formaldehyde	3	D	0.00019-0.00024 (0.00038-0.00048)	0.00022 (0.00043)	40
Fabric filter	ND	45	Filterable PM	3	C	0.0019-0.0030 (0.0037-0.0060)	0.0024 (0.0048)	40
Fabric filter[b]	ND	45	Formaldehyde	3	D	0.00044-0.00049 (0.00089-0.00098)	0.00047 (0.00094)	40
Fabric filter	Waste oil	35	Filterable PM	3	C	0.0062-0.011 (0.012-0.022)	0.0078 (0.016)	40
Fabric filter[b]	Waste oil	35	Formaldehyde	3	D	0.0020-0.0050 (0.0039-0.010)	0.0033 (0.0066)	40
Fabric filter	Waste oil	25	Filterable PM	3	C	0.00043-0.00045 (0.00087-0.00091)	0.00044 (0.00089)	40
Fabric filter[b]	Waste oil	25	Formaldehyde	3	D	0.00054-0.0012 (0.0011-0.0023)	0.00089 (0.0018)	40
Fabric filter	Waste oil	40	Filterable PM	3	C	0.0030-0.0042 (0.0061-0.0084)	0.0035 (0.0071)	40
Fabric filter[b]	Waste oil	40	Formaldehyde	3	D	0.0025-0.0049 (0.0050-0.0098)	0.0035 (0.0071)	40
Fabric filter	ND	0	Filterable PM	3	C	0.0098-0.013 (0.020-0.025)	0.011 (0.022)	40
Fabric filter[b]	ND	0	Formaldehyde	3	D	0.00031-0.00032 (0.00062-0.00064)	0.00032 (0.00063)	40
Fabric filter	Waste oil	52	Filterable PM	3	C	0.0041-0.0059 (0.0083-0.012)	0.0049 (0.0097)	40
Fabric filter[b]	Waste oil	52	Formaldehyde	3	D	0.0011-0.0036 (0.0022-0.0073)	0.0020 (0.0040)	40
Fabric filter	ND	20	Filterable PM	3	C	0.017-0.032 (0.033-0.065)	0.026 (0.053)	40
Fabric filter[b]	ND	20	Formaldehyde	3	D	0.00048-0.00092 (0.00096-0.0018)	0.00063 (0.0013)	40
Fabric filter	Waste oil	40	Filterable PM	3	C	0.0015-0.0027 (0.0030-0.0053)	0.0019 (0.0038)	40
Fabric filter[b]	Waste oil	40	Formaldehyde	3	D	0.0018-0.0020 (0.0036-0.0039)	0.0019 (0.0038)	40
Fabric filter	Waste oil	0	Filterable PM	3	C	0.0055-0.0083 (0.011-0.017)	0.0069 (0.014)	40
Fabric filter[b]	Waste oil	0	Formaldehyde	3	D	0.00029-0.00037 (0.00058-0.00075)	0.00034 (0.00067)	40
Fabric filter	No. 2 fuel oil	40	Filterable PM	3	C	0.0018-0.0037 (0.0037-0.0074)	0.0026 (0.0053)	40
Fabric filter[b]	No. 2 fuel oil	40	Formaldehyde	3	D	0.00025-0.00044 (0.00050-0.00088)	0.00033 (0.00065)	40
Fabric filter	Natural gas	30	CO	1	C	NA	0.094 (0.19)	44

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	30	CO_2	3	A	13 (25-26)	13 (25)	44
Fabric filter[b]	Natural gas	30	SO_2	3	A	0.0014-0.0030 (0.0028-0.0059)	0.0021 (0.0041)	44
Fabric filter[b]	Natural gas	30	NO_x	3	A	0.0075 (0.015)	0.0075 (0.015)	44
Fabric filter[b]	Natural gas	30	TOC as propane	3	A	0.029-0.055 (0.058-0.11)	0.040 (0.080)	44
Fabric filter[b]	Natural gas	30	Methane	3	A	0.013-0.032 (0.025-0.063)	0.019 (0.038)	44
Fabric filter[b]	Natural gas	30	Benzene	3	A	0.00053-0.00068 (0.0011-0.0014)	0.00060 (0.0012)	44
Fabric filter[b]	Natural gas	30	Toluene	3	A	$5.5x10^{-5}$-$2.1x10^{-4}$ (0.00011-0.00041)	0.00011 (0.00022)	44
Fabric filter[b]	Natural gas	30	Ethyl benzene	2	B	$5.5x10^{-5}$-$2.4x10^{-4}$ (0.00011-0.00047)	0.00015 (0.00029)	44
Fabric filter[b]	Natural gas	30	Xylene	3	A	$6.5x10^{-5}$-$3.1x10^{-4}$ (0.00013-0.00062)	0.00020 (0.00040)	44
Fabric filter	Natural gas	30	Naphthalene	3	A	$2.5x10^{-5}$-$2.9x10^{-5}$ ($4.9x10^{-5}$-$5.7x10^{-5}$)	$2.6x10^{-5}$ ($5.3x10^{-5}$)	44
Fabric filter	Natural gas	30	2-Methylnaphthalene	3	A	$2.2x10^{-5}$-$2.9x10^{-5}$ ($4.3x10^{-5}$-$5.7x10^{-5}$)	$2.5x10^{-5}$ ($4.9x10^{-5}$)	44
Fabric filter	Natural gas	30	Phenanthrene	3	A	$4.9x10^{-6}$-$5.5x10^{-6}$ ($9.7x10^{-6}$-$1.1x10^{-5}$)	$5.1x10^{-6}$ ($1.0x10^{-5}$)	44
Fabric filter[b]	Natural gas	0	Formaldehyde	3	A	0.0039-0.0050 (0.0078-0.010)	0.0043 (0.0086)	44
Fabric filter	Natural gas	30	Filterable PM	3	A	0.0038-0.0070 (0.0076-0.014)	0.0051 (0.010)	44
Fabric filter	Natural gas	30	Condensable PM	3	A	0.0017-0.0034 (0.0034-0.0067)	0.0023 (0.0046)	44
Fabric filter[b]	Natural gas	13	Filterable PM	3	A	0.0017-0.0034 (0.0034-0.0068)	0.0028 (0.0056)	45
Fabric filter[b]	Natural gas	13	Condensable PM	3	A	0.00033-0.00060 (0.00065-0.0012)	0.00048 (0.00096)	45
Fabric filter[b]	Natural gas	13	CO_2	3	A	16 (31-32)	16 (31)	45
Fabric filter[b]	Natural gas	13	SO_2	3	A	0.00060-0.00065 (0.0012-0.0013)	0.00062 (0.0012)	45
Fabric filter[b]	Natural gas	13	NO_x	3	A	0.0085-0.0099 (0.017-0.020)	0.0091 (0.018)	45
Fabric filter[b]	Natural gas	13	TOC as propane	3	A	0.016-0.025 (0.032-0.050)	0.020 (0.039)	45
Fabric filter[b]	Natural gas	13	Methane	3	A	0.00082-0.0031 (0.0016-0.0062)	0.0016 (0.0032)	45
Fabric filter[b]	Natural gas	13	Benzene	2	B	0.00012-0.00028 (0.00024-0.00056)	0.00020 (0.00040)	45

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	Natural gas	13	Toluene[c]	3	C	$2.2x10^{-5}$-$2.3x10^{-5}$ ($4.3x10^{-5}$-$4.6x10^{-5}$)	$2.2x10^{-5}$ ($4.5x10^{-5}$)	45
Fabric filter[b]	Natural gas	13	Ethylbenzene[c]	3	C	$2.5x10^{-5}$-$2.7x10^{-5}$ ($4.9x10^{-5}$-$5.4x10^{-5}$)	$2.6x10^{-5}$ ($5.1x10^{-5}$)	45
Fabric filter[b]	Natural gas	13	Xylene[c]	3	C	$2.5x10^{-5}$-$2.7x10^{-5}$ ($4.9x10^{-5}$-$5.4x10^{-5}$)	$2.6x10^{-5}$ ($5.1x10^{-5}$)	45
Fabric filter	Natural gas	13	Naphthalene	3	A	$3.2x10^{-5}$-$3.7x10^{-5}$ ($6.3x10^{-5}$-$7.4x10^{-5}$)	$3.5x10^{-5}$ ($7.0x10^{-5}$)	45
Fabric filter	Natural gas	13	2-Methylnaphthalene	3	A	$1.5x10^{-5}$-$1.9x10^{-5}$ ($3.0x10^{-5}$-$3.7x10^{-5}$)	$1.7x10^{-5}$ ($3.3x10^{-5}$)	45
Fabric filter	Natural gas	13	Acenaphthylene	3	A	$1.1x10^{-5}$-$1.3x10^{-5}$ ($2.1x10^{-5}$-$2.5x10^{-5}$)	$1.1x10^{-5}$ ($2.3x10^{-5}$)	45
Fabric filter	Natural gas	13	Fluorene	3	A	$4.4x10^{-6}$-$5.0x10^{-6}$ ($8.8x10^{-6}$-$1.0x10^{-5}$)	$4.9x10^{-6}$ ($9.8x10^{-6}$)	45
Fabric filter	Natural gas	13	Phenanthrene	3	A	$2.9x10^{-6}$-$3.7x10^{-6}$ ($5.7x10^{-6}$-$7.4x10^{-6}$)	$3.3x10^{-6}$ ($6.6x10^{-6}$)	45
Fabric filter	Natural gas	13	Fluoranthene	3	A	$2.9x10^{-7}$-$4.0x10^{-7}$ ($5.7x10^{-7}$-$8.0x10^{-7}$)	$3.6x10^{-7}$ ($7.2x10^{-7}$)	45
Fabric filter	Natural gas	13	Pyrene	2	B	$2.7x10^{-7}$-$4.3x10^{-7}$ ($5.3x10^{-7}$-$8.6x10^{-7}$)	$3.5x10^{-7}$ ($6.9x10^{-7}$)	45
Fabric filter[b]	Natural gas	13	Formaldehyde	3	A	0.00010-0.0012 (0.00020-0.0023)	0.00078 (0.0016)	45
Fabric filter[b]	Natural gas	0	CO	5	A	0.021-0.044 (0.043-0.088)	0.028 (0.056)	48
Fabric filter[b]	Natural gas	0	CO_2	6	A	13-21 (26-41)	17 (34)	48
Fabric filter[b]	Natural gas	0	SO_2	5	A	0.00082-0.0047 (0.0017-0.0095)	0.0024 (0.0048)	48
Fabric filter[b]	Natural gas	0	NO_x	6	A	0.014-0.065 (0.027-0.13)	0.025 (0.049)	48
Fabric filter[b]	Natural gas	0	TOC as propane	6	A	0.00085-0.0070 (0.0017-0.014)	0.0037 (0.0073)	48
Fabric filter[b]	Natural gas	0	Methane[c]	3	C	0.00082-0.0031 (0.00012-0.00015)	$6.8x10^{-5}$ (0.00014)	48
Fabric filter[b]	Natural gas	0	Benzene[c]	3	C	0.00029-0.00036 (0.00057-0.00072)	0.00033 (0.00066)	48
Fabric filter[b]	Natural gas	0	Toluene[c]	3	C	0.00034-0.00043 (0.00068-0.00085)	0.00039 (0.00078)	48
Fabric filter[b]	Natural gas	0	Ethylbenzene[c]	3	C	0.00039-0.00049 (0.00078-0.00098)	0.00045 (0.00090)	48
Fabric filter[b]	Natural gas	0	Xylene[c]	3	C	0.00039-0.00049 (0.00078-0.00098)	0.00045 (0.00090)	48
Fabric filter	Natural gas	0	Naphthalene	3	A	$2.8x10^{-5}$-$2.9x10^{-5}$ ($5.6x10^{-5}$-$5.8x10^{-5}$)	$2.8x10^{-5}$ ($5.7x10^{-5}$)	48
Fabric filter	Natural gas	0	2-Methylnaphthalene	3	A	$6.6x10^{-5}$-$7.3x10^{-5}$ ($1.3x10^{-4}$-$1.5x10^{-4}$)	$7.1x10^{-5}$ ($1.4x10^{-4}$)	48

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Cumene	3	A	$5.5x10^{-6}$-$5.0x10^{-5}$ ($1.1x10^{-5}$-0.00010)	$2.1x10^{-5}$ ($4.3x10^{-5}$)	48
Fabric filter	Natural gas	0	Acenaphthylene	3	A	$8.5x10^{-7}$-$1.8x10^{-6}$ ($1.7x10^{-6}$-$3.5x10^{-6}$)	$1.3x10^{-6}$ ($2.7x10^{-6}$)	48
Fabric filter	Natural gas	0	Acenaphthene	3	A	$5.5x10^{-7}$-$1.8x10^{-6}$ ($1.1x10^{-6}$-$3.6x10^{-6}$)	$1.1x10^{-6}$ ($2.2x10^{-6}$)	48
Fabric filter	Natural gas	0	Fluorene	3	A	$8.0x10^{-7}$-$2.0x10^{-6}$ ($1.6x10^{-6}$-$4.0x10^{-6}$)	$1.2x10^{-6}$ ($2.5x10^{-6}$)	48
Fabric filter	Natural gas	0	Phenanthrene	3	A	$4.5x10^{-6}$-$1.0x10^{-5}$ ($9.0x10^{-6}$-$2.1x10^{-5}$)	$6.9x10^{-6}$ ($1.4x10^{-5}$)	48
Fabric filter	Natural gas	0	Anthracene	3	A	$1.2x10^{-7}$-$2.7x10^{-7}$ ($2.3x10^{-7}$-$5.5x10^{-7}$)	$1.8x10^{-7}$ ($3.6x10^{-7}$)	48
Fabric filter	Natural gas	0	Fluoranthene	3	A	$2.6x10^{-7}$-$8.5x10^{-7}$ ($5.2x10^{-7}$-$1.7x10^{-6}$)	$5.3x10^{-7}$ ($1.1x10^{-6}$)	48
Fabric filter	Natural gas	0	Pyrene	3	A	$2.9x10^{-7}$-$5.6x10^{-7}$ ($5.8x10^{-7}$-$1.2x10^{-6}$)	$4.5x10^{-7}$ ($9.0x10^{-7}$)	48
Fabric filter	Natural gas	0	Benzo(a)anthracene	3	A	$2.7x10^{-8}$-$2.3x10^{-7}$ ($5.5x10^{-8}$-$4.6x10^{-7}$)	$1.0x10^{-7}$ ($2.1x10^{-7}$)	48
Fabric filter	Natural gas	0	Chrysene	3	A	$8.8x10^{-8}$-$2.3x10^{-7}$ ($1.8x10^{-7}$-$5.6x10^{-7}$)	$1.8x10^{-7}$ ($3.6x10^{-7}$)	48
Fabric filter	Natural gas	0	Benzo(b)fluoranthene	3	A	$4.0x10^{-8}$-$1.2x10^{-7}$ ($8.1x10^{-8}$-$2.5x10^{-7}$)	$7.6x10^{-8}$ ($1.5x10^{-7}$)	48
Fabric filter	Natural gas	0	Benzo(k)fluoranthene	3	A	$1.4x10^{-8}$-$4.5x10^{-8}$ ($2.8x10^{-8}$-$9.0x10^{-8}$)	$2.7x10^{-8}$ ($5.4x10^{-8}$)	48
Fabric filter	Natural gas	0	Benzo(e)pyrene	3	A	$1.6x10^{-8}$-$1.2x10^{-7}$ ($3.2x10^{-8}$-$2.4x10^{-7}$)	$5.4x10^{-8}$ ($1.1x10^{-7}$)	48
Fabric filter	Natural gas	0	Benzo(a)pyrene	3	A	$1.7x10^{-9}$-$1.1x10^{-8}$ ($3.4x10^{-9}$-$2.2x10^{-8}$)	$4.9x10^{-9}$ ($9.8x10^{-9}$)	48
Fabric filter	Natural gas	0	Perylene	2	B	$4.5x10^{-10}$-$9.0x10^{-9}$ ($9.0x10^{-10}$-$1.8x10^{-8}$)	$4.4x10^{-9}$ ($8.8x10^{-9}$)	48
Fabric filter	Natural gas	0	Indeno(1,2,3-cd) pyrene	3	A	$2.5x10^{-9}$-$4.3x10^{-9}$ ($5.0x10^{-9}$-$8.6x10^{-9}$)	$3.5x10^{-9}$ ($7.0x10^{-9}$)	48
Fabric filter	Natural gas	0	Benzo(g,h,i)perylene	3	A	$8.4x10^{-9}$-$2.7x10^{-8}$ ($1.8x10^{-8}$-$5.4x10^{-8}$)	$2.0x10^{-8}$ ($4.0x10^{-8}$)	48
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0021-0.0036 (0.0041-0.0071)	0.0026 (0.0053)	48
Fabric filter	Natural gas	0	Condensable inorganic PM	3	A	0.00045-0.0015 (0.00090-0.0029)	0.0010 (0.0021)	48
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.00012-0.00050 (0.00024-0.0010)	0.00036 (0.00071)	48
Fabric filter[b]	No. 2 fuel oil	35	CO	9	C	0.23-0.35 (0.46-0.69)	0.30 (0.60)	50
Fabric filter[b]	No. 2 fuel oil	35	CO_2	9	A	29-37 (57-73)	32 (65)	50
Fabric filter[b]	No. 2 fuel oil	35	SO_2	5	A	0.0033-0.0085 (0.0066-0.017)	0.0054 (0.011)	50

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	No. 2 fuel oil	35	NO_x	9	A	0.031-0.049 (0.062-0.098)	0.041 (0.081)	50
Fabric filter[b]	No. 2 fuel oil	35	TOC as propane	9	A	0.012-0.025 (0.024-0.050)	0.018 (0.036)	50
Fabric filter[b]	No. 2 fuel oil	35	Methane	9	A	0.0025-0.010 (0.0051-0.020)	0.0071 (0.014)	50
Fabric filter[b]	No. 2 fuel oil	35	Benzene[c]	9	C	$9.5x10^{-5}$-0.00039 (0.00019-0.00078)	0.00015 (0.00030)	50
Fabric filter[b]	No. 2 fuel oil	35	Toluene[c]	9	C	0.00012-0.00017 (0.00023-0.00034)	0.00015 (0.00029)	50
Fabric filter[b]	No. 2 fuel oil	35	Ethylbenzene[c]	9	C	0.00014-0.00032 (0.00027-0.00063)	0.00019 (0.00038)	50
Fabric filter[b]	No. 2 fuel oil	35	Xylene[c]	9	C	0.00013-0.00020 (0.00026-0.00039)	0.00017 (0.00034)	50
Fabric filter	No. 2 fuel oil	35	Naphthalene	3	A	$7.2x10^{-5}$-$8.5x10^{-5}$ (0.00014-0.00017)	$7.6x10^{-5}$ (0.00015)	50
Fabric filter	No. 2 fuel oil	35	2-Methylnaphthalene	3	A	$8.3x10^{-5}$-$8.8x10^{-5}$ (0.00017-0.00018)	$8.5x10^{-5}$ (0.00017)	50
Fabric filter	No. 2 fuel oil	35	Acenaphthylene	3	A	$9.5x10^{-6}$-$1.4x10^{-5}$ ($1.9x10^{-5}$-$2.8x10^{-5}$)	$1.1x10^{-5}$ ($2.2x10^{-5}$)	50
Fabric filter	No. 2 fuel oil	35	Fluorene	3	A	$8.0x10^{-6}$-$9.4x10^{-6}$ ($1.6x10^{-5}$-$1.9x10^{-5}$)	$8.5x10^{-6}$ ($1.7x10^{-5}$)	50
Fabric filter	No. 2 fuel oil	35	Phenanthrene	3	A	$2.6x10^{-5}$-$3.0x10^{-5}$ ($5.2x10^{-5}$-$6.0x10^{-5}$)	$2.8x10^{-5}$ ($5.5x10^{-5}$)	50
Fabric filter	No. 2 fuel oil	35	Anthracene	3	A	$1.6x10^{-6}$-$2.2x10^{-6}$ ($3.2x10^{-6}$-$4.4x10^{-6}$)	$1.8x10^{-6}$ ($3.6x10^{-6}$)	50
Fabric filter	No. 2 fuel oil	35	Pyrene	2	B	$1.1x10^{-6}$-$1.9x10^{-6}$ ($2.1x10^{-6}$-$3.9x10^{-6}$)	$1.5x10^{-6}$ ($3.0x10^{-6}$)	50
Fabric filter[b]	No. 2 fuel oil	35	Formaldehyde	3	A	0.0011-0.0017 (0.0022-0.0033)	0.0014 (0.0027)	50
Fabric filter	No. 2 fuel oil	35	Filterable PM	3	A	0.0014-0.0017 (0.0027-0.0034)	0.0015 (0.0029)	50
Fabric filter	No. 2 fuel oil	35	Cond. PM	3	A	0.0083-0.012 (0.017-0.023)	0.010 (0.019)	50
Fabric filter	Natural gas	28	Filterable PM	3	A	0.0015-0.0075 (0.0029-0.015)	0.0037 (0.0073)	51
Fabric filter	Natural gas	28	Condensable organic PM	3	A	0.00029-0.00032 (0.00058-0.00065)	0.00031 (0.00061)	51
Fabric filter	Natural gas	28	CO_2	3	A	17-18 (35-36)	18 (36)	51
Fabric filter	Fuel oil	31	Filterable PM	3	A	0.0043-0.0069 (0.0087-0.014)	0.0053 (0.011)	53
Fabric filter	Fuel oil	31	Condensable organic PM	3	A	0.021-0.021 (0.041-0.043)	0.021 (0.042)	53
Fabric filter	Fuel oil	31	CO_2	3	A	18-21 (36-41)	19 (39)	53

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 6 fuel oil	44	Filterable PM	3	A	0.0041-0.0067 (0.0082-0.013)	0.0051 (0.010)	54
Fabric filter	No. 6 fuel oil	44	Condensable organic PM	3	A	0.0060-0.0081 (0.012-0.016)	0.0069 (0.014)	54
Fabric filter	No. 6 fuel oil	44	CO_2	3	A	12-15 (24-30)	13 (27)	54
Fabric filter	No. 6 fuel oil	32	Filterable PM	3	A	0.0047-0.0055 (0.0095-0.011)	0.0050 (0.010)	55
Fabric filter	No. 6 fuel oil	32	Condensable organic PM	3	A	0.00089-0.0012 (0.0018-0.0024)	0.0010 (0.0020)	55
Fabric filter	No. 6 fuel oil	32	CO_2	3	A	16-19 (32-37)	18 (35)	55
Fabric filter	Natural gas	30	Filterable PM-10	3	C	0.00094-0.0012 (0.0019-0.0025)	0.0011 (0.0023)	56
Fabric filter	Natural gas	30	Condensable organic PM	3	C	0.00044-0.00058 (0.00088-0.0012)	0.00053 (0.0011)	56
Fabric filter	Natural gas	30	CO_2	3	A	13-14 (26-27)	13 (26)	56
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.046-0.051 (0.091-0.10)	0.048 (0.096)	57
Venturi scrubber	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0043-0.0056 (0.0086-0.011)	0.0049 (0.0097)	57
Venturi scrubber	No. 6 fuel oil	0	CO_2	3	A	20-23 (40-47)	22 (44)	57
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	2	B	0.098-0.11 (0.20-0.22)	0.10 (0.21)	58
Venturi scrubber	No. 6 fuel oil	0	Condensable organic PM	2	B	0.010-0.013 (0.020-0.026)	0.012 (0.023)	58
Venturi scrubber	No. 6 fuel oil	0	CO_2	2	B	43-50 (87-100)	47 (94)	58
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.023-0.027 (0.047-0.054)	0.026 (0.052)	59
Venturi scrubber	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0028-0.0039 (0.0057-0.0077)	0.0035 (0.0070)	59
Venturi scrubber	No. 6 fuel oil	0	CO_2	3	A	16-18 (32-36)	17 (34)	59
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.021-0.026 (0.043-0.051)	0.024 (0.048)	60
Venturi scrubber	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0076-0.0092 (0.015-0.018)	0.0084 (0.017)	60
Venturi scrubber	No. 6 fuel oil	0	CO_2	3	A	19-24 (37-48)	21 (42)	60
Fabric filter	No. 6 fuel oil	52	Filterable PM	3	A	0.0020-0.0025 (0.0039-0.0050)	0.0022 (0.0043)	63
Fabric filter	No. 6 fuel oil	52	Condensable inorganic PM	3	A	0.00084-0.0029 (0.0017-0.0057)	0.0016 (0.0032)	63

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 6 fuel oil	52	Condensable organic PM	3	A	0.0064-0.0076 (0.013-0.015)	0.0070 (0.014)	63
Fabric filter	No. 6 fuel oil	52	CO_2	3	A	2.9-16 (5.7-32)	7.5 (15)	63
Fabric filter	No. 6 fuel oil	40	Filterable PM	3	A	0.0035-0.0058 (0.0035-0.012)	0.0046 (0.0092)	64
Fabric filter	No. 6 fuel oil	40	Condensable organic PM	3	A	0.0039-0.015 (0.0078-0.031)	0.0093 (0.019)	64
Fabric filter	No. 6 fuel oil	40	CO_2	3	A	16-17 (32-34)	16 (33)	64
Fabric filter	Butane	30	Filterable PM	3	A	0.0025-0.0032 (0.0050-0.0064)	0.0029 (0.0058)	65
Fabric filter	Butane	30	Condensable organic PM	3	A	0.00012-0.00026 (0.00024-0.00052)	0.00018 (0.00035)	65
Fabric filter	Butane	30	CO_2	3	A	20-22 (40-45)	21 (42)	65
Wet scrubber	No. 6 fuel oil	0	Filterable PM	2	B	0.011-0.014 (0.021-0.027)	0.012 (0.024)	67
Wet scrubber	No. 6 fuel oil	0	Condensable organic PM	2	B	0.012-0.016 (0.024-0.032)	0.014 (0.028)	67
Wet scrubber	No. 6 fuel oil	0	CO_2	2	B	30-33 (60-67)	32 (63)	67
Wet scrubber	No. 6 fuel oil	46	Filterable PM	3	A	0.0055-0.0070 (0.011-0.014)	0.0064 (0.013)	67
Wet scrubber	No. 6 fuel oil	46	Condensable organic PM	3	A	0.047-0.055 (0.093-0.11)	0.052 (0.10)	67
Wet scrubber	No. 6 fuel oil	46	CO_2	3	A	29-30 (57-60)	29 (59)	67
Fabric filter	No. 6 fuel oil	48	Filterable PM	3	A	0.0012-0.0015 (0.0023-0.0031)	0.0013 (0.0027)	68
Fabric filter	No. 6 fuel oil	48	Condensable organic PM	3	A	0.018-0.024 (0.036-0.048)	0.020 (0.041)	68
Fabric filter	No. 6 fuel oil	48	CO_2	3	A	13-15 (27-30)	14 (28)	68
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.017-0.022 (0.034-0.044)	0.020 (0.040)	70
Venturi scrubber	No. 6 fuel oil	0	Condensable organic PM	3	A	0.00027-0.0036 (0.00054-0.0072)	0.0014 (0.0029)	70
Venturi scrubber	No. 6 fuel oil	0	CO_2	3	A	13-19 (27-38)	17 (34)	70
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0024-0.0036 (0.0048-0.0072)	0.0030 (0.0059)	71
Fabric filter	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0011-0.0020 (0.0021-0.0040)	0.0017 (0.0033)	71
Fabric filter	No. 6 fuel oil	0	CO_2	3	A	21-24 (42-48)	23 (45)	71

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 6 fuel oil	31	Filterable PM	3	A	0.0022-0.0028 (0.0044-0.0056)	0.0025 (0.0050)	73
Fabric filter	No. 6 fuel oil	31	Condensable organic PM	3	A	0.0043-0.014 (0.0087-0.029)	0.0095 (0.019)	73
Fabric filter	No. 6 fuel oil	31	CO_2	3	A	17-17 (33-34)	17 (34)	73
Fabric filter	No. 6 fuel oil	18	Filterable PM	3	A	0.0031-0.0042 (0.0063-0.0084)	0.0036 (0.0072)	74
Fabric filter	No. 6 fuel oil	18	Condensable organic PM	3	A	0.011-0.015 (0.023-0.030)	0.013 (0.026)	74
Fabric filter	No. 6 fuel oil	18	CO_2	3	A	10-11 (21-22)	11 (22)	74
Venturi scrubber	Propane	0	Filterable PM	2	B	0.019-0.033 (0.038-0.065)	0.026 (0.052)	75
Venturi scrubber	Propane	0	Condensable organic PM	3	A	0.0021-0.0043 (0.0042-0.0086)	0.0032 (0.0063)	75
Venturi scrubber	Propane	0	CO_2	3	A	12-14 (25-28)	13 (27)	75
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0027-0.0074 (0.0055-0.015)	0.0044 (0.0088)	78
Fabric filter	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0012-0.0050 (0.0025-0.010)	0.0029 (0.0059)	78
Fabric filter	No. 6 fuel oil	0	CO_2	3	A	20-20 (40-41)	20 (40)	78
Fabric filter	No. 6 fuel oil	50	Filterable PM	3	A	0.0047-0.0063 (0.0093-0.013)	0.0057 (0.011)	81
Fabric filter	No. 6 fuel oil	50	Condensable inorganic PM	3	A	0.0025-0.0034 (0.0051-0.0068)	0.0031 (0.0062)	81
Fabric filter	No. 6 fuel oil	50	Condensable organic PM	3	A	0.0062-0.0071 (0.012-0.014)	0.0065 (0.013)	81
Fabric filter	No. 6 fuel oil	50	CO_2	3	A	13-15 (25-30)	14 (28)	81
Fabric filter	No. 2 fuel oil	42	Filterable PM	3	A	0.0016-0.0019 (0.0032-0.0039)	0.0018 (0.0036)	82
Fabric filter	No. 2 fuel oil	42	Condensable organic PM	3	A	0.0050-0.0071 (0.0099-0.014)	0.0057 (0.011)	82
Fabric filter	No. 2 fuel oil	42	CO_2	3	A	19-45 (37-90)	36 (71)	82
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0037-0.0074 (0.0074-0.015)	0.0059 (0.012)	84
Fabric filter	Natural gas	0	CO_2	3	B	20-23 (40-46)	21 (43)	84
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	C	0.012-0.018 (0.023-0.036)	0.014 (0.027)	85
Venturi scrubber	No. 2 fuel oil	0	Condensable inorganic PM	3	C	0.00074-0.0012 (0.0015-0.0025)	0.00094 (0.0019)	85

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	No. 2 fuel oil	0	Condensable organic PM	3	C	0.0011-0.0017 (0.0021-0.0034)	0.0013 (0.0026)	85
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	C	17-22 (34-45)	19 (38)	85
Venturi scrubber	Natural gas/ coal	0	Filterable PM	3	A	0.0053-0.0072 (0.011-0.014)	0.0062 (0.012)	87
Venturi scrubber	Natural gas/ coal	0	Condensable inorganic PM	3	A	0.00089-0.0026 (0.0018-0.0052)	0.0017 (0.0033)	87
Venturi scrubber	Natural gas/ coal	0	Condensable organic PM	3	A	0.0023-0.0038 (0.0046-0.0077)	0.0033 (0.0066)	87
Venturi scrubber	Natural gas/ coal	0	CO_2	3	B	26-29 (52-58)	27 (54)	87
Venturi scrubber	Natural gas/ coal	0	Filterable PM	2	B	0.013-0.014 (0.026-0.029)	0.014 (0.027)	88
Venturi scrubber	Natural gas/ coal	0	SO_2	3	A	0.0011-0.0014 (0.0021-0.0028)	0.0012 (0.0024)	88
Venturi scrubber	Natural gas/ coal	0	CO_2	3	B	18-20 (36-40)	19 (38)	88
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0018-0.0024 (0.0037-0.0049)	0.0021 (0.0042)	89
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	15-17 (30-34)	16 (32)	89
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.012-0.014 (0.025-0.028)	0.013 (0.027)	90
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	20-21 (40-42)	20 (41)	90
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0026-0.0033 (0.0052-0.0065)	0.0030 (0.0060)	91
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	14-14 (28-29)	14 (28)	91
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0032-0.0044 (0.0065-0.0089)	0.0038 (0.0077)	92
Fabric filter	Natural gas	0	CO_2	3	B	13-13 (26-27)	13 (26)	92
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.053-0.056 (0.11-0.11)	0.054 (0.11)	93
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	17-18 (34-35)	17 (35)	93
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.010-0.013 (0.021-0.027)	0.012 (0.024)	94
Fabric filter	No. 2 fuel oil	0	Condensable inorganic PM	3	A	0.0042-0.0073 (0.0084-0.015)	0.0059 (0.012)	94
Fabric filter	No. 2 fuel oil	0	Condensable organic PM	3	A	0.0010-0.0029 (0.0021-0.0058)	0.0021 (0.0043)	94
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	15-17 (30-33)	16 (31)	94

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0043-0.0082 (0.0087-0.016)	0.0063 (0.013)	95
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15-16 (30-33)	15 (31)	95
Venturi scrubber	ND	0	Filterable PM	3	B	0.0015-0.0026 (0.0030-0.0053)	0.0020 (0.0040)	96
Venturi scrubber	ND	0	CO_2	3	B	9.3-10 (19-21)	10 (20)	96
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0090-0.011 (0.018-0.022)	0.0098 (0.020)	99
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	23-25 (46-51)	24 (48)	99
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0076-0.011 (0.015-0.021)	0.0090 (0.018)	101
Fabric filter	No. 6 fuel oil	0	Condensable inorganic PM	3	A	0.0069-0.011 (0.014-0.023)	0.0084 (0.017)	101
Fabric filter	No. 6 fuel oil	0	Condensable organic PM	3	A	0.0018-0.0022 (0.0036-0.0044)	0.0021 (0.0041)	101
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	30-32 (61-65)	31 (63)	101
Fabric filter	Natural gas	15	Filterable PM	3	A	0.0031-0.0076 (0.0061-0.015)	0.0052 (0.010)	103
Fabric filter	Natural gas	15	CO_2	3	B	4.4-4.5 (8.8-9.0)	4.5 (8.9)	103
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0049-0.013 (0.010-0.026)	0.0096 (0.019)	104
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	16-20 (32-39)	18 (36)	104
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	B	0.0042-0.012 (0.0083-0.025)	0.0083 (0.017)	105
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	15-21 (30-43)	19 (38)	105
Fabric filter	Natural gas	26	Filterable PM	3	A	0.0011-0.0046 (0.0022-0.0091)	0.0023 (0.0046)	107
Fabric filter	Natural gas	26	CO_2	3	B	3.4-6.0 (6.7-12)	5.1 (10)	107
Venturi scrubber	Fuel oil/coal	0	Filterable PM	2	B	0.034-0.038 (0.067-0.077)	0.036 (0.072)	108
Venturi scrubber	Fuel oil/coal	0	CO_2	2	B	11-22 (21-43)	16 (32)	108
Venturi scrubber	Fuel oil/coal	0	SO_2	2	B	0.0022-0.0072 (0.0043-0.014)	0.0047 (0.0094)	108
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.010-0.039 (0.020-0.078)	0.027 (0.053)	109
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	11-15 (22-29)	13 (25)	109

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0073-0.0080 (0.015-0.016)	0.0076 (0.015)	112
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	9.7-18 (19-36)	13 (26)	112
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0013-0.0033 (0.0025-0.0066)	0.0020 (0.0040)	114
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	12-15 (25-30)	14 (27)	114
Fabric filter	Propane	12	Filterable PM	3	A	0.0018-0.0026 (0.0036-0.0053)	0.0021 (0.0042)	117
Fabric filter	Propane	12	CO_2	3	B	5.1-8.1 (10-16)	6.1 (12)	117
Fabric filter	Natural gas	0	Filterable PM	3	A	0.00098-0.0019 (0.0020-0.0037)	0.0013 (0.0026)	118
Fabric filter	Natural gas	0	CO_2	3	B	8.7-12 (17-24)	10 (21)	118
Venturi scrubber	Fuel oil	0	Filterable PM	3	A	0.014-0.025 (0.028-0.050)	0.018 (0.036)	119
Venturi scrubber	Fuel oil	0	Cond. inorganic PM	3	A	0.0018-0.0026 (0.0036-0.0052)	0.0021 (0.0043)	119
Venturi scrubber	Fuel oil	0	CO_2	3	C	18-22 (35-43)	19 (39)	119
Venturi scrubber	Fuel oil	0	SO_2	3	C	0.0023-0.0024 (0.0046-0.0049)	0.0023 (0.0047)	119
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0055-0.0076 (0.011-0.015)	0.0069 (0.014)	121
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14-16 (28-33)	15 (30)	121
Fabric filter	No. 2 fuel oil	16	Filterable PM	3	A	0.0056-0.0078 (0.011-0.016)	0.0069 (0.014)	122
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0066-0.0090 (0.013-0.018)	0.0078 (0.016)	123
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	12-14 (23-28)	13 (25)	123
Fabric filter	No. 2 fuel oil	22	Filterable PM	3	A	0.0013-0.0027 (0.0026-0.0054)	0.0019 (0.0038)	124
Fabric filter	No. 2 fuel oil	22	CO_2	3	B	8.5-9.9 (17-20)	9.3 (19)	124
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0022-0.0080 (0.0044-0.016)	0.0051 (0.010)	125
Fabric filter	No. 2 fuel oil	0	Condensable inorganic PM	3	A	0.00087-0.0085 (0.0017-0.017)	0.0034 (0.0068)	125
Fabric filter	No. 2 fuel oil	0	Condensable organic PM	3	A	0.0012-0.0053 (0.0024-0.011)	0.0032 (0.0064)	125
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	11-13 (21-25)	11 (23)	125

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0043-0.0059 (0.0086-0.012)	0.0048 (0.0097)	128
Fabric filter	No. 4 fuel oil	0	CO_2	3	B	20-21 (40-42)	20 (41)	128
Fabric filter	No. 4 fuel oil	0	Filterable PM	2	B	0.0014-0.0036 (0.0029-0.0072)	0.0025 (0.0050)	130
Fabric filter	No. 4 fuel oil	0	Condensable inorganic PM	2	B	0.0015-0.0024 (0.0030-0.0047)	0.0019 (0.0039)	130
Fabric filter	No. 4 fuel oil	0	Condensable organic PM	2	B	0.0015-0.0025 (0.0030-0.0049)	0.0020 (0.0039)	130
Fabric filter	No. 4 fuel oil	0	CO_2	2	B	16-16 (31-31)	16 (31)	130
Fabric filter	Coal/natural gas	0	Filterable PM	3	A	0.012-0.018 (0.024-0.035)	0.014 (0.029)	132
Fabric filter	Coal/natural gas	0	Condensable inorganic PM	3	A	0.0056-0.0097 (0.011-0.019)	0.0082 (0.016)	132
Fabric filter	Coal/natural gas	0	Condensable organic PM	3	A	0.0019-0.0034 (0.0038-0.0067)	0.0028 (0.0056)	132
Fabric filter	Coal/natural gas	0	CO_2	3	B	17-21 (33-42)	19 (37)	132
Fabric filter	Coal/natural gas	0	Filterable PM	3	A	0.0040-0.0052 (0.0080-0.010)	0.0046 (0.0092)	133
Fabric filter	Coal/natural gas	0	Condensable inorganic PM	3	A	0.0023-0.011 (0.0046-0.021)	0.0061 (0.012)	133
Fabric filter	Coal/natural gas	0	Condensable organic PM	3	A	0.00010-0.00075 (0.00021-0.0015)	0.00042 (0.00083)	133
Fabric filter	Coal/natural gas	0	CO_2	3	B	6.5-10 (13-20)	8.5 (17)	133
Fabric filter	Propane	0	Filterable PM	2	A	0.0047-0.0060 (0.0094-0.012)	0.0053 (0.011)	137
Fabric filter	Propane	0	CO_2	2	B	11-11 (21-22)	11 (22)	137
Fabric filter	Propane	31	Filterable PM	2	A	0.015-0.017 (0.031-0.034)	0.016 (0.032)	137
Fabric filter	Propane	31	CO_2	2	B	7.7-10 (15-21)	9.0 (18)	137
Venturi scrubber	No. 2 fuel oil	29	Filterable PM	3	A	0.011-0.013 (0.021-0.026)	0.012 (0.024)	141
Venturi scrubber	No. 2 fuel oil	29	CO_2	3	B	17-19 (33-37)	18 (36)	141
Venturi scrubber	No. 2 fuel oil	29	Formaldehyde	3	D	0.00029-0.00034 (0.00058-0.00069)	0.00031 (0.00062)	141
Venturi scrubber	No. 5 fuel oil	35	Filterable PM	3	B	0.011-0.013 (0.022-0.027)	0.012 (0.024)	142
Venturi scrubber	No. 5 fuel oil	35	Condensable inorganic PM	3	B	0.00090-0.0034 (0.0018-0.0068)	0.0019 (0.0039)	142

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	No. 5 fuel oil	35	Condensable organic PM	3	B	0.027-0.032 (0.055-0.063)	0.029 (0.058)	142
Venturi scrubber	No. 5 fuel oil	35	CO_2	3	B	23-25 (45-50)	24 (48)	142
Venturi scrubber	No. 5 fuel oil	35	Cadmium	3	D	2.2x10^{-7}-4.3x10^{-7} (4.3x10^{-7}-8.7x10^{-7})	3.6x10^{-7} (7.2x10^{-7})	142
Venturi scrubber	No. 5 fuel oil	35	Chromium	3	D	1.7x10^{-6}-3.5x10^{-6} (3.5x10^{-6}-7.0x10^{-6})	2.5x10^{-6} (5.1x10^{-6})	142
Venturi scrubber	No. 5 fuel oil	35	Lead	3	D	5.7x10^{-5}-8.3x10^{-5} (0.00011-0.00017)	7.1x10^{-5} (0.00014)	142
Venturi scrubber	No. 5 fuel oil	35	Nickel	3	D	1.5x10^{-6}-2.8x10^{-6} (3.0x10^{-6}-5.7x10^{-6})	2.0x10^{-6} (4.1x10^{-6})	142
Venturi scrubber	No. 5 fuel oil	35	Arsenic	3	D	6.5x10^{-8}-1.3x10^{-7} (1.3x10^{-7}-2.6x10^{-7})	8.7x10^{-8} (1.7x10^{-7})	142
Venturi scrubber	No. 5 fuel oil	35	Hexavalent chromium	3	D	2.2x10^{-7}-4.3x10^{-7} (4.3x10^{-7}-8.7x10^{-7})	2.9x10^{-7} (5.8x10^{-7})	142
Fabric filter	Natural gas	38	Filterable PM	2	B	0.0092-0.011 (0.018-0.022)	0.010 (0.020)	144
Fabric filter	Natural gas	38	CO_2	2	B	11-13 (21-25)	12 (23)	144
Venturi scrubber	Natural gas	31	Filterable PM	3	A	0.0083-0.012 (0.017-0.023)	0.010 (0.021)	146
Venturi scrubber	Natural gas	31	CO_2	3	A	12-13 (25-25)	12 (25)	146
Venturi scrubber	Natural gas	31	Formaldehyde	3	D	0.00065-0.00089 (0.0013-0.0018)	0.00079 (0.0016)	146
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0010-0.0030 (0.0020-0.0059)	0.0023 (0.0046)	147
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	17-19 (34-38)	18 (35)	147
Venturi scrubber	No. 5 fuel oil	50	Filterable PM	3	A	0.0046-0.0086 (0.0092-0.017)	0.0070 (0.014)	148
Venturi scrubber	No. 5 fuel oil	50	Condensable inorganic PM	3	A	0.0081-0.013 (0.016-0.026)	0.010 (0.020)	148
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0031-0.0084 (0.0061-0.017)	0.0050 (0.010)	149
Fabric filter	No. 2 fuel oil	0	CO	3	A	0.069-0.10 (0.14-0.21)	0.086 (0.17)	149
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.0018-0.0044 (0.0037-0.0088)	0.0029 (0.0058)	149
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14-17 (27-33)	15 (30)	149
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.048-0.055 (0.097-0.11)	0.051 (0.10)	153
Fabric filter	No. 2 fuel oil	ND	CO_2	5	B	0.57-2.8 (1.1-5.6)	1.3 (2.6)	153

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	ND	NO_x	3	B	0.010-0.019 (0.020-0.038)	0.016 (0.032)	153
Fabric filter	No. 2 fuel oil	ND	TOC as propane	3	B	0.0055-0.0068 (0.011-0.014)	0.0062 (0.012)	153
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0020-0.0038 (0.0040-0.0076)	0.0031 (0.0063)	154
Fabric filter	No. 2 fuel oil	0	CO	1	C	NA	0.091 (0.18)	154
Fabric filter	No. 2 fuel oil	0	TOC as propane	1	C	NA	0.012 (0.023)	154
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	10-18 (21-37)	14 (28)	154
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0014-0.0026 (0.0028-0.0051)	0.0021 (0.0041)	160
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	29-31 (57-62)	30 (59)	160
Venturi scrubber	No. 2 fuel oil	0	Cadmium	2	C	$2.4x10^{-7}$-$1.1x10^{-6}$ ($4.7x10^{-7}$-$2.1x10^{-6}$)	$6.4x10^{-7}$ ($1.3x10^{-6}$)	162
Venturi scrubber	No. 2 fuel oil	0	Copper	2	C	$1.2x10^{-7}$-$3.2x10^{-7}$ ($2.4x10^{-7}$-$6.3x10^{-7}$)	$2.2x10^{-7}$ ($4.4x10^{-7}$)	162
Venturi scrubber	No. 2 fuel oil	0	Mercury	2	B	$8.0x10^{-7}$-$3.2x10^{-6}$ ($1.6x10^{-6}$-$6.4x10^{-6}$)	$2.0x10^{-6}$ ($4.0x10^{-6}$)	162
Venturi scrubber	No. 2 fuel oil	0	Lead	4	B	$6.0x10^{-7}$-$7.0x10^{-6}$ ($1.2x10^{-6}$-$1.4x10^{-5}$)	$2.6x10^{-6}$ ($5.3x10^{-6}$)	162
Venturi scrubber	No. 2 fuel oil	0	Zinc	2	B	$2.9x10^{-5}$-$3.8x10^{-5}$ ($5.7x10^{-5}$-$7.6x10^{-5}$)	$3.3x10^{-5}$ ($6.6x10^{-5}$)	162
Venturi scrubber	No. 2 fuel oil	0	Manganese	2	B	$4.6x10^{-6}$-$1.4x10^{-5}$ ($9.1x10^{-6}$-$2.8x10^{-5}$)	$9.3x10^{-6}$ ($1.9x10^{-5}$)	162
Venturi scrubber	No. 2 fuel oil	0	CO_2	8	B	15-32 (30-63)	25 (50)	162
Venturi scrubber	No. 2 fuel oil	0	Chromium	2	B	$1.5x10^{-6}$-$1.7x10^{-6}$ ($3.0x10^{-6}$-$3.4x10^{-6}$)	$1.6x10^{-6}$ ($3.2x10^{-6}$)	162
Venturi scrubber	No. 2 fuel oil	0	Naphthalene	2	B	0.00070-0.0010 (0.0014-0.0020)	0.00086 (0.0017)	162
Venturi scrubber	No. 2 fuel oil	0	Phenanthrene	2	B	$3.1x10^{-6}$-$8.0x10^{-6}$ ($6.1x10^{-6}$-$1.6x10^{-5}$)	$5.5x10^{-6}$ ($1.1x10^{-5}$)	162
Venturi scrubber	No. 2 fuel oil	0	Anthracene	2	C	$2.7x10^{-7}$-$2.3x10^{-6}$ ($5.4x10^{-7}$-$4.5x10^{-6}$)	$1.3x10^{-6}$ ($2.5x10^{-6}$)	162
Fabric filter	Natural gas	0	Copper	3	A	$1.5x10^{-6}$-$2.1x10^{-6}$ ($3.0x10^{-6}$-$4.1x10^{-6}$)	$1.7x10^{-6}$ ($3.4x10^{-6}$)	163
Fabric filter	Natural gas	0	Mercury	3	A	$1.8x10^{-7}$-$3.0x10^{-7}$ ($3.5x10^{-7}$-$6.0x10^{-7}$)	$2.4x10^{-7}$ ($4.7x10^{-7}$)	163
Fabric filter	Natural gas	0	Nickel	3	A	$2.1x10^{-6}$-$7.5x10^{-6}$ ($4.1x10^{-6}$-$1.5x10^{-5}$)	$4.8x10^{-6}$ ($9.6x10^{-6}$)	163
Fabric filter	Natural gas	0	Zinc	3	A	$1.9x10^{-5}$-$2.2x10^{-5}$ ($3.8x10^{-5}$-$4.3x10^{-5}$)	$2.0x10^{-5}$ ($4.0x10^{-5}$)	163

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Manganese	3	A	$4.8x10^{-6}$-$1.2x10^{-5}$ ($9.5x10^{-6}$-$2.4x10^{-5}$)	$7.4x10^{-6}$ ($1.5x10^{-5}$)	163
Fabric filter	Natural gas	0	CO_2	8	A	9.0-18 (18-35)	14 (28)	163
Fabric filter	Natural gas	0	Chromium	2	B	$6.5x10^{-7}$-$3.9x10^{-6}$ ($1.3x10^{-6}$-$7.7x10^{-6}$)	$2.3x10^{-6}$ ($4.5x10^{-6}$)	163
Fabric filter	Natural gas	0	Hexavalent chromium	2	C	$1.2x10^{-7}$-$3.4x10^{-7}$ ($2.3x10^{-7}$-$6.7x10^{-7}$)	$2.3x10^{-7}$ ($4.5x10^{-7}$)	163
Fabric filter	Natural gas	0	Naphthalene	3	A	0.00012-0.00014 (0.00024-0.00028)	0.00013 (0.00026)	163
Fabric filter	Natural gas	0	Fluorene	3	A	$1.0x10^{-6}$-$1.3x10^{-6}$ ($2.0x10^{-6}$-$2.5x10^{-6}$)	$1.1x10^{-6}$ ($2.2x10^{-6}$)	163
Fabric filter	Natural gas	0	Phenanthrene	3	A	$1.6x10^{-6}$-$2.3x10^{-6}$ ($3.1x10^{-6}$-$4.5x10^{-6}$)	$1.9x10^{-6}$ ($3.8x10^{-6}$)	163
Fabric filter	No. 2 fuel oil	0	Copper	3	A	$1.7x10^{-6}$-$5.0x10^{-6}$ ($3.4x10^{-6}$-$1.0x10^{-5}$)	$3.6x10^{-6}$ ($7.1x10^{-6}$)	164
Fabric filter	No. 2 fuel oil	0	Mercury	3	A	$2.7x10^{-6}$-$3.1x10^{-6}$ ($5.4x10^{-6}$-$6.2x10^{-6}$)	$2.9x10^{-6}$ ($5.7x10^{-6}$)	164
Fabric filter	No. 2 fuel oil	0	Nickel	3	A	$6.0x10^{-6}$-0.00022 ($1.2x10^{-5}$-0.00044)	0.00015 (0.00029)	164
Fabric filter	No. 2 fuel oil	0	Lead	3	A	$1.2x10^{-6}$-$3.4x10^{-6}$ ($2.4x10^{-6}$-$6.7x10^{-6}$)	$2.0x10^{-6}$ ($4.1x10^{-6}$)	164
Fabric filter	No. 2 fuel oil	0	Zinc	3	A	$8.0x10^{-5}$-0.00017 (0.00016-0.00033)	0.00012 (0.00023)	164
Fabric filter	No. 2 fuel oil	0	Manganese	3	A	$3.1x10^{-6}$-$2.2x10^{-5}$ ($6.1x10^{-6}$-$4.3x10^{-5}$)	$1.5x10^{-5}$ ($3.1x10^{-5}$)	164
Fabric filter	No. 2 fuel oil	0	CO_2	9	A	15-21 (29-41)	19 (37)	164
Fabric filter	No. 2 fuel oil	0	Chromium	3	A	$5.5x10^{-6}$-$1.2x10^{-5}$ ($1.1x10^{-5}$-$2.3x10^{-5}$)	$8.0x10^{-6}$ ($1.6x10^{-5}$)	164
Fabric filter	No. 2 fuel oil	0	Naphthalene	3	A	$4.2x10^{-5}$-0.00025 ($8.3x10^{-5}$-0.00050)	0.00014 (0.00028)	164
Fabric filter	No. 2 fuel oil	0	Fluorene	3	A	$7.5x10^{-7}$-$3.2x10^{-6}$ ($1.5x10^{-6}$-$6.3x10^{-6}$)	$2.0x10^{-6}$ ($4.1x10^{-6}$)	164
Fabric filter	No. 2 fuel oil	0	Phenanthrene	3	A	$8.0x10^{-7}$-$2.7x10^{-6}$ ($1.6x10^{-6}$-$5.3x10^{-6}$)	$1.7x10^{-6}$ ($3.3x10^{-6}$)	164
Venturi scrubber	No. 2 fuel oil	ND	Filterable PM	3	D	0.23-0.40 (0.46-0.79)	0.30 (0.60)	166
Venturi scrubber	No. 2 fuel oil	ND	CO_2	3	A	15-16 (31-33)	16 (32)	166
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0025-0.0056 (0.0051-0.011)	0.0041 (0.0081)	167
Fabric filter	Natural gas	0	CO_2	3	B	8.6-9.5 (17-19)	9.0 (18)	167
Fabric filter	Natural gas	30	Filterable PM	1	C	NA	0.0036 (0.0073)	168

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	21,30,30	CO_2	3	C	15-16 (30-31)	15 (31)	168
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	B	0.0025-0.0048 (0.0050-0.0097)	0.0038 (0.0076)	171
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	13-15 (27-30)	14 (29)	171
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0072-0.011 (0.015-0.021)	0.0090 (0.018)	172
Venturi scrubber	Natural gas	0	CO_2	3	A	8.4-12 (17-23)	9.4 (19)	172
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0056-0.011 (0.011-0.022)	0.0082 (0.016)	174
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	18-21 (36-43)	20 (40)	174
Fabric filter	No. 2 fuel oil	0	Filterable PM	2	B	0.0032-0.0032 (0.0063-0.0065)	0.0032 (0.0063)	175
Fabric filter	No. 2 fuel oil	0	CO_2	2	B	15-16 (30-31)	15 (31)	175
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0034-0.0071 (0.0067-0.014)	0.0048 (0.0097)	180
Fabric filter	Natural gas	0	CO_2	3	A	8.3-12 (17-23)	9.8 (20)	180
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	C	0.0062-0.011 (0.012-0.021)	0.0084 (0.017)	173
Fabric filter	No. 2 fuel oil	ND	Condensable inorganic PM	3	C	0.00043-0.0025 (0.00087-0.0050)	0.0011 (0.0023)	173
Fabric filter	No. 2 fuel oil	ND	Condensable organic PM	3	C	0-0.0029 (0-0.0057)	0.0012 (0.0023)	173
Fabric filter	No. 2 fuel oil	ND	CO_2	3	C	22-24 (44-48)	23 (46)	173
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0017-0.0020 (0.0034-0.0041)	0.0018 (0.0037)	182
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	10-11 (21-22)	11 (22)	182
Venturi scrubber	Waste oil	0	Filterable PM	3	B	0.014-0.025 (0.028-0.051)	0.019 (0.038)	179
Venturi scrubber	Waste oil	0	CO_2	3	B	23-24 (45-48)	24 (47)	179
Venturi scrubber	Waste oil	0	Lead	3	B	$5.3x10^{-5}$-$5.8x10^{-5}$ (0.00011-0.00012)	$5.6x10^{-5}$ (0.00011)	179
Fabric filter	No. 4 waste oil	0	Filterable PM	3	A	0.0023-0.0047 (0.0046-0.0093)	0.0033 (0.0065)	178
Fabric filter	No. 4 waste oil	0	CO_2	3	A	17-21 (35-43)	19 (39)	178
Fabric filter	No. 4 waste oil	0	Lead	3	A	$4.2x10^{-7}$-$7.3x10^{-7}$ ($8.4x10^{-7}$-$1.5x10^{-6}$)	$6.0x10^{-7}$ ($1.2x10^{-6}$)	178

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	No. 4 waste oil	0	Filterable PM	3	A	0.0058-0.0075 (0.012-0.015)	0.0066 (0.013)	183
Venturi scrubber	No. 4 waste oil	0	CO_2	3	A	6.0-9.9 (12-20)	8.0 (16)	183
Venturi scrubber	No. 4 waste oil	0	Lead	3	A	$4.2x10^{-5}$-$5.5x10^{-5}$ ($8.4x10^{-5}$-0.00011)	$4.8x10^{-5}$ ($9.6x10^{-5}$)	183
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.012-0.019 (0.024-0.039)	0.016 (0.033)	186
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	21-23 (43-46)	22 (44)	186
Wet Scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0025-0.0065 (0.0050-0.013)	0.0049 (0.0098)	187
Wet Scrubber	No. 2 fuel oil	0	CO_2	3	A	5.1-9.5 (10-19)	7.3 (15)	187
Fabric filter	Coal/ natural gas	0	Filterable PM	2	A	0.0044-0.0087 (0.0088-0.017)	0.0065 (0.013)	189
Fabric filter	Coal/ natural gas	0	CO_2	3	B	13-13 (25-26)	13 (26)	189
Fabric filter	Coal/ natural gas	0	SO_2	3	A	0.044-0.53 (0.089-1.1)	0.38 (0.75)	189
Fabric filter	Coal/ natural gas	0	Filterable PM	3	A	0.0036-0.010 (0.0072-0.021)	0.0060 (0.012)	190
Fabric filter	Coal/ natural gas	0	CO_2	3	A	14-15 (29-31)	15 (30)	190
Fabric filter	Coal/ natural gas	0	SO_2	3	A	0.0058-0.0067 (0.012-0.013)	0.0062 (0.012)	190
Wet Scrubber	ND	ND	Filterable PM	3	C	0.038-0.065 (0.076-0.13)	0.048 (0.097)	191
Wet Scrubber	ND	ND	CO_2	3	C	12-19 (25-39)	16 (32)	191
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	A	0.0039-0.0074 (0.0077-0.015)	0.0056 (0.011)	192
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	21-23 (42-47)	23 (45)	192
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	NR	0.0041-0.0081 (0.0081-0.016)	0.0064 (0.013)	196
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	6.4-13 (13-26)	11 (21)	196
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.0032-0.0073 (0.0065-0.015)	0.0056 (0.011)	197
Fabric filter	Natural gas	ND	CO_2	3	B	11-12 (22-24)	12 (23)	197
Fabric filter	Natural gas	ND	CO	3	B	0.0017-0.0082 (0.0034-0.016)	0.0055 (0.011)	197
Fabric filter	Natural gas	6	Filterable PM	3	A	0.0016-0.0026 (0.0032-0.0051)	0.0021 (0.0041)	198

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	6	CO_2	3	A	11-12 (22-24)	11 (23)	198
Fabric filter	No. 4 fuel oil	14	Filterable PM	3	A	0.0063-0.015 (0.013-0.029)	0.011 (0.023)	205
Fabric filter	No. 4 fuel oil	14	CO_2	3	A	6.7-9.5 (13-19)	8.3 (17)	205
Fabric filter	Propane	ND	Filterable PM	3	A	0.0014-0.0021 (0.0028-0.0043)	0.0019 (0.0037)	206
Fabric filter	Propane	ND	Condensable inorganic PM	3	A	0.00089-0.0014 (0.0018-0.0029)	0.0012 (0.0023)	206
Fabric filter	Propane	ND	CO_2	3	A	9.4-10 (19-20)	9.7 (19)	206
Fabric filter	Propane	ND	Filterable PM	3	B	0.0047-0.0051 (0.0094-0.010)	0.0049 (0.0098)	209
Fabric filter	Propane	ND	CO_2	3	B	13-13 (27-27)	13 (27)	209
Fabric filter	Propane	ND	CO	3	B	2.5-3.8 (4.9-7.7)	3.0 (6.0)	209
Fabric filter	Propane	ND	NO_x	3	B	0.015-0.017 (0.030-0.033)	0.016 (0.032)	209
Fabric filter	Propane	ND	TOC as propane	3	B	0.015-0.033 (0.029-0.066)	0.022 (0.044)	209
Fabric filter	Propane	10	Filterable PM	3	B	0.0030-0.0097 (0.0061-0.019)	0.0064 (0.013)	210
Fabric filter	Propane	10	CO_2	3	B	14-16 (29-32)	15 (30)	210
Fabric filter	Propane	10	TOC as propane	3	B	0.056-0.060 (0.11-0.12)	0.059 (0.12)	210
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0020-0.0027 (0.0039-0.0054)	0.0022 (0.0045)	211
Venturi scrubber	Natural gas	0	CO_2	3	B	14-16 (28-33)	15 (30)	211
Venturi scrubber	Natural gas	0	TOC as propane	3	A	0.036-0.050 (0.072-0.10)	0.042 (0.083)	211
Venturi scrubber	Natural gas	25% (4th run)	Filterable PM	4	A	0.0014-0.0030 (0.0028-0.0060)	0.0022 (0.0045)	212
Venturi scrubber	Natural gas	25% (4th run)	CO_2	4	B	12-14 (24-27)	13 (25)	212
Venturi scrubber	Natural gas	25% (4th run)	TOC as propane	4	A	0.017-0.028 (0.034-0.055)	0.023 (0.046)	212
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0098-0.011 (0.020-0.022)	0.010 (0.021)	214

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	ND	PM-1	3	A	0.0029-0.0031 (0.0057-0.0062)	0.0030 (0.0060)	214
Fabric filter	No. 2 fuel oil	ND	PM-2.5	3	A	0.0046-0.0050 (0.0091-0.010)	0.0049 (0.0097)	214
Fabric filter	No. 2 fuel oil	ND	NO_x	3	A	0.024-0.026 (0.049-0.051)	0.025 (0.050)	214
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	14-15 (28-30)	14 (29)	214
Fabric filter	No. 2 fuel oil	ND	CO	3	A	0.014-0.015 (0.027-0.030)	0.014 (0.028)	214
Fabric filter	No. 2 fuel oil	ND	TOC	3	A	0.0070-0.0076 (0.014-0.015)	0.0073 (0.015)	214
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0091-0.014 (0.018-0.027)	0.012 (0.024)	218
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	7.7-17 (15-33)	11 (22)	218
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0019-0.0082 (0.0038-0.016)	0.0047 (0.0095)	221
Fabric filter	Natural gas	0	CO_2	3	A	7.2-9.3 (14-19)	8.5 (17)	221
Fabric filter	Propane	0	Filterable PM	3	A	0.0016-0.0017 (0.0031-0.034)	0.0016 (0.0033)	223
Fabric filter	Propane	0	CO_2	3	A	10-14 (20-27)	12 (24)	223
Fabric filter	No. 2 fuel oil	ND	PM-10	2	B	0.0029-0.0029 (0.0057-0.0058)	0.0029 (0.0058)	229
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.012-0.013 (0.023-0.025)	0.012 (0.024)	229
Fabric filter	No. 2 fuel oil	ND	PM-2.5	2	B	0.00054-0.00085 (0.0011-0.0017)	0.00069 (0.0014)	229
Fabric filter	No. 2 fuel oil	ND	PM-1	2	B	5.5×10^{-5}-0.00040 (0.00011-0.00080)	0.00023 (0.00045)	229
Fabric filter	No. 2 fuel oil	ND	CO	3	A	0.020-0.026 (0.040-0.051)	0.024 (0.047)	229
Fabric filter	No. 2 fuel oil	ND	NO_x	3	A	0.012-0.014 (0.024-0.026)	0.012 (0.025)	229
Fabric filter	No. 2 fuel oil	ND	CO_2	2	C	12-12 (24-24)	12 (24)	229
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.017-0.026 (0.035-0.052)	0.022 (0.044)	241
Venturi scrubber	No. 2 fuel oil	0	TOC as propane	3	A	0.018-0.020 (0.035-0.039)	0.018 (0.037)	241
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	16-17 (31-34)	16 (33)	241
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.00070-0.00098 (0.0014-0.0020)	0.00083 (0.0017)	242

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.013-0.017 (0.026-0.034)	0.015 (0.030)	242
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	14-14 (27-29)	14 (28)	242
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0054-0.0085 (0.011-0.017)	0.0071 (0.014)	243
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	15-20 (29-40)	18 (35)	243
Fabric filter (continuous mix)	Natural gas	0	Filterable PM	3	A	0.0074-0.0093 (0.015-0.019)	0.0081 (0.016)	244
Fabric filter (continuous mix)	Natural gas	0	CO_2	3	A	11-14 (21-28)	12 (25)	244
Fabric filter	Propane	0	Filterable PM	2	B	0.0076-0.0091 (0.015-0.018)	0.0084 (0.017)	245
Fabric filter	Propane	0	CO_2	4	B	15-18 (30-35)	16 (33)	245
Fabric filter	No. 2 fuel oil	6.9	Filterable PM	3	A	0.0048-0.017 (0.0097-0.033)	0.011 (0.022)	246
Fabric filter	No. 2 fuel oil	6.9	CO_2	3	A	14-15 (27-31)	14 (29)	246
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0077-0.0089 (0.016-0.018)	0.0084 (0.017)	247
Fabric filter	Natural gas	0	CO_2	3	A	8.8-11 (18-21)	9.8 (20)	247
Venturi scrubber	No. 2 fuel oil	ND	Filterable PM	3	B	0.0042-0.0052 (0.0083-0.010)	0.0046 (0.0093)	251
Venturi scrubber	No. 2 fuel oil	ND	Condensable organic PM	3	B	0.0011-0.0033 (0.0021-0.0065)	0.0023 (0.0046)	251
Venturi scrubber	No. 2 fuel oil	ND	Condensable inorganic PM	3	B	0.0040-0.0053 (0.0079-0.011)	0.0047 (0.0093)	251
Venturi scrubber	No. 2 fuel oil	ND	CO_2	3	B	17-18 (35-35)	18 (35)	251
Fabric filter	Propane	20	Filterable PM	3	B	0.0026-0.0050 (0.0053-0.010)	0.0038 (0.0076)	252
Fabric filter	Propane	20	Condensable organic PM	3	B	0.00025-0.00057 (0.00049-0.0011)	0.00040 (0.00081)	252
Fabric filter	Propane	20	Condensable inorganic PM	3	B	0.0032-0.0040 (0.0063-0.0080)	0.0035 (0.0070)	252
Fabric filter	Propane	20	CO_2	3	B	17-20 (34-39)	18 (36)	252
Fabric filter	Propane	20	Filterable PM	3	B	0.0078-0.017 (0.016-0.035)	0.013 (0.025)	254
Fabric filter	Propane	20	Condensable organic PM	3	B	$1.7x10^{-5}$-0.00050 ($3.5x10^{-5}$-0.0010)	0.00021 (0.00042)	254

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Propane	20	Condensable inorganic PM	3	B	0.0012-0.0051 (0.0024-0.010)	0.0029 (0.0058)	254
Fabric filter	Propane	20	CO	3	B	0.081-0.084 (0.16-0.17)	0.082 (0.17)	254
Fabric filter	Propane	20	CO_2	3	B	15-19 (29-37)	17 (34)	254
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	2	B	0.0017-0.0019 (0.0034-0.0038)	0.0018 (0.0036)	255
Venturi scrubber	No. 2 fuel oil	0	SO_2	3	A	$7.5x10^{-5}$-0.0012 (0.00015-0.0023)	0.00048 (0.00095)	255
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	16-28 (33-57)	24 (48)	255
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0011-0.0012 (0.0022-0.0023)	0.0011 (0.0022)	257
Fabric filter	Natural gas	0	CO_2	3	A	11-11 (21-22)	11 (22)	257
Venturi scrubber	Natural gas	0	Filterable PM	2	B	0.0067-0.0076 (0.013-0.015)	0.0072 (0.014)	258
Venturi scrubber	Natural gas	0	CO_2	3	B	29-40 (58-80)	33 (66)	258
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0078-0.0085 (0.016-0.017)	0.0081 (0.016)	259
Venturi scrubber	Natural gas	0	CO_2	3	A	4.0-5.0 (8.1-9.9)	4.5 (9.0)	259
Fabric filter	ND	0	Filterable PM	3	C	0.0028-0.0080 (0.0056-0.016)	0.0053 (0.011)	260
Fabric filter	ND	0	CO_2	3	C	21-21 (42-42)	21 (42)	260
Venturi scrubber	Propane	11	Filterable PM	3	A	0.0061-0.0074 (0.012-0.015)	0.0068 (0.014)	262
Venturi scrubber	Propane	11	Condensable organic PM	3	A	0.0082-0.013 (0.016-0.027)	0.011 (0.022)	262
Venturi scrubber	Propane	11	Condensable inorganic PM	3	A	0.00040-0.00084 (0.00080-0.0016)	0.00059 (0.0012)	262
Venturi scrubber	Propane	11	CO_2	3	A	15-18 (29-36)	17 (33)	262
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.00074-0.0013 (0.0015-0.0025)	0.00096 (0.0019)	269
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15-16 (30-32)	15 (31)	269
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.00030-0.0027 (0.00061-0.0054)	0.0018 (0.0036)	267
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	12-13 (23-25)	12 (25)	267
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.014-0.018 (0.028-0.036)	0.015 (0.030)	266

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	33-35 (66-71)	34 (68)	266
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0040-0.0074 (0.0080-0.015)	0.0053 (0.011)	273
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15-18 (31-35)	16 (33)	273
Fabric filter	Natural gas	0	Filterable PM	2	B	0.013-0.013 (0.027-0.027)	0.013 (0.027)	280
Fabric filter	Natural gas	0	CO_2	2	B	23-27 (45-53)	25 (49)	280
Fabric filter	Fuel oil	0	Filterable PM	3	A	0.00053-0.00065 (0.0011-0.0013)	0.00058 (0.0012)	292
Fabric filter	Fuel oil	0	CO_2	3	A	8.8-12 (18-23)	9.8 (20)	292
Fabric filter	Fuel oil	0	Condensable inorganic PM	3	A	0.00087-0.0019 (0.0017-0.0037)	0.0014 (0.0027)	292
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0015-0.0046 (0.0030-0.0092)	0.0028 (0.0056)	293
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	13-15 (26-29)	14 (27)	293
Fabric filter	Propane	10	Filterable PM	3	A	0.0017-0.0053 (0.0034-0.011)	0.0030 (0.0059)	294
Fabric filter	Propane	10	CO_2	3	A	12-15 (24-29)	13 (27)	294
Fabric filter	Natural gas	30	Filterable PM	3	A	0.0011-0.0017 (0.0022-0.0034)	0.0013 (0.0026)	295
Fabric filter	Natural gas	30	CO_2	3	A	11-13 (22-26)	12 (23)	295
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0032-0.0080 (0.0064-0.016)	0.0062 (0.012)	297
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	10-12 (20-23)	11 (22)	297
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0053-0.0055 (0.011-0.011)	0.0054 (0.011)	298
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	9.6-12 (19-25)	11 (22)	298
Fabric filter (used neutralizing agent to reduce SO_2)	No. 6 fuel oil	19	SO_2	3	A	0.075-0.083 (0.15-0.17)	0.081 (0.16)	299
Fabric filter	No. 6 fuel oil	ND	Filterable PM	3	B	0.0083-0.013 (0.017-0.027)	0.010 (0.021)	300
Fabric filter	No. 6 fuel oil	ND	SO_2	3	B	0.0038-0.013 (0.0076-0.025)	0.0077 (0.015)	300
Fabric filter	No. 6 fuel oil	ND	CO_2	3	B	16-16 (32-33)	16 (32)	300

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 4/6 fuel oil	24	Filterable PM	3	B	0.011-0.017 (0.021-0.033)	0.013 (0.026)	301
Fabric filter	No. 4/6 fuel oil	24	CO_2	3	B	11-12 (22-24)	12 (23)	301
Fabric filter	No. 4/6 fuel oil	24	HCl	3	B	$1.3x10^{-5}$-0.00023 ($2.7x10^{-5}$-0.00045)	0.00011 (0.00022)	301
Fabric filter	No. 4/6 fuel oil	24	Cd	3	B	$7.4x10^{-8}$-$7.4x10^{-8}$ ($1.5x10^{-7}$-$1.5x10^{-7}$)	$7.4x10^{-8}$ ($1.5x10^{-7}$)	301
Fabric filter	No. 4/6 fuel oil	24	Cr	3	B	$7.4x10^{-7}$-$7.4x10^{-7}$ ($1.5x10^{-6}$-$1.5x10^{-6}$)	$7.4x10^{-7}$ ($1.5x10^{-6}$)	301
Fabric filter	No. 4/6 fuel oil	24	Lead	3	B	$1.9x10^{-6}$-$1.9x10^{-6}$ ($3.8x10^{-6}$-$3.9x10^{-6}$)	$1.9x10^{-6}$ ($3.8x10^{-6}$)	301
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0054-0.012 (0.011-0.024)	0.0083 (0.017)	303
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	12-18 (24-36)	16 (31)	303
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0023-0.0037 (0.0045-0.0074)	0.0030 (0.0060)	309
Fabric filter	Natural gas	0	CO_2	3	A	13-16 (27-33)	15 (29)	309
Fabric filter	Natural gas	0	Condensable inorganic PM	3	A	0.0015-0.0019 (0.0030-0.0038)	0.0018 (0.0035)	309
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0057-0.0080 (0.012-0.016)	0.0069 (0.014)	311
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	16-18 (32-37)	17 (34)	311
Fabric filter	No. 2 fuel oil	0	Condensable inorganic PM	3	A	0.0029-0.0062 (0.0059-0.012)	0.0042 (0.0083)	311
Fabric filter	No. 4 fuel oil	10	Filterable PM	2	B	0.0055-0.0067 (0.011-0.013)	0.0061 (0.012)	315
Fabric filter	No. 4 fuel oil	10	CO_2	3	B	18-19 (36-37)	19 (37)	315
Fabric filter	No. 4 fuel oil	10	Lead	2	B	$3.8x10^{-6}$-$4.2x10^{-6}$ ($7.6x10^{-6}$-$8.4x10^{-6}$)	$4.0x10^{-6}$ ($8.0x10^{-6}$)	315
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0057-0.0080 (0.012-0.016)	0.0069 (0.014)	316
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	16-18 (32-37)	17 (34)	316
Fabric filter	No. 2 fuel oil	0	Condensable inorganic PM	3	A	0.0029-0.0062 (0.0059-0.012)	0.0041 (0.0083)	316
Venturi scrubber	No. 4 fuel oil	0	Filterable PM	3	A	0.0010-0.0031 (0.0020-0.0063)	0.0021 (0.0042)	322
Venturi scrubber	No. 4 fuel oil	0	CO_2	3	A	3.9-4.0 (7.7-7.9)	3.9 (7.8)	322
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0034-0.012 (0.0068-0.024)	0.0064 (0.013)	324

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	11-17 (22-33)	14 (28)	324
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0021-0.0050 (0.0041-0.010)	0.0036 (0.0071)	329
Fabric filter	Natural gas	0	CO_2	3	A	5.7-8.7 (12-18)	6.8 (14)	329
Fabric filter	Natural gas	0	Filterable PM	3	B	0.0011-0.0020 (0.0022-0.0039)	0.0015 (0.0030)	330
Fabric filter	Natural gas	0	CO_2	3	B	14-15 (29-30)	15 (29)	330
Fabric filter	Natural gas	0	Condensable inorganic PM	3	B	0.0011-0.0028 (0.0021-0.0056)	0.0018 (0.0036)	330
Fabric filter	Natural gas	0	Condensable organic PM	3	B	0.0016-0.0026 (0.0033-0.0051)	0.0021 (0.0042)	330
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0083-0.0090 (0.017-0.018)	0.0086 (0.017)	332
Venturi scrubber	Natural gas	0	CO_2	3	A	11-11 (21-23)	11 (22)	332
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0064-0.0070 (0.013-0.014)	0.0066 (0.013)	333
Venturi scrubber	Natural gas	0	CO_2	3	A	8.2-14 (16-28)	10 (21)	333
Fabric filter	No. 2 fuel oil	0	Filterable PM	5	A	0.0024-0.0081 (0.0047-0.016)	0.0051 (0.010)	334
Fabric filter	No. 2 fuel oil	0	CO_2	5	A	14-26 (29-51)	18 (37)	334
Fabric filter	NA	ND	Filterable PM	3	C	0.00058-0.00065 (0.0012-0.0013)	0.00061 (0.0012)	335
Fabric filter	NA	ND	CO_2	3	C	15-17 (29-34)	16 (31)	335
Fabric filter	Propane	10	Filterable PM	3	A	0.0056-0.010 (0.011-0.020)	0.0078 (0.016)	236
Fabric filter	Propane	10	CO_2	3	A	18-21 (35-43)	19 (38)	236
Fabric filter	Propane	10	VOC (TGNMO)	2	D	0.026-0.038 (0.053-0.075)	0.032 (0.064)	236
Venturi scrubber	No. 2 fuel oil	10	Filterable PM	2	B	0.017-0.019 (0.035-0.038)	0.018 (0.036)	268
Venturi scrubber	No. 2 fuel oil	10	CO_2	2	B	26-26 (52-53)	26 (52)	268
Venturi scrubber	No. 2 fuel oil	10	Condensable inorganic PM	2	B	0.0010-0.0066 (0.0021-0.013)	0.0038 (0.0077)	268
Venturi scrubber	No. 2 fuel oil	10	Condensable organic PM	2	B	0.0013-0.0015 (0.0026-0.0030)	0.0014 (0.0028)	268
None	ND	30	Filterable PM-15	4	A	ND	27% of filt. PM	23

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	ND	30	Filterable PM-10	4	A	ND	23% of filt. PM	23
None	ND	30	Filterable PM-2.5	4	A	ND	5.5% of filt. PM	23
Fabric filter	ND	30	Filterable PM-15	4	A	ND	35% of filt. PM	23
Fabric filter	ND	30	Filterable PM-10	4	A	ND	32% of filt. PM	23
Fabric filter	ND	30	PM-2.5	4	A	ND	11% of filt. PM	23
Fabric filter	Recycled No. 2 fuel oil	23[d]	Toluene	4	B	0-0.0059 (0-0.012)	0.0015 (0.0031)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Hexane	4	A	0.00018-0.0017 (0.00037-0.0034)	0.00092 (0.0018)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Ethylene	4	A	0.0017-0.0057 (0.0034-0.011)	0.0036 (0.0073)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Methane	4	A	0.0016-0.0079 (0.0033-0.016)	0.0041 (0.0082)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	SO_2	4	A	0.019-0.033 (0.039-0.067)	0.027 (0.054)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	CO	4	A	0.056-0.18 (0.11-0.36)	0.10 (0.20)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Formaldehyde	4	A	0.00078-0.0043 (0.0016-0.0086)	0.0026 (0.0051)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	3-Methylpentane	4	B	0-0.00021 (0-0.00042)	8.2E-5 (0.00016)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Isooctane	4	B	0-6.2E-5 (0-0.00012)	1.6E-5 (3.1E-5)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Butane	4	B	0-0.00088 (0-0-0.0018)	0.00033 (0.00067)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2-Methyl-1-pentene	4	A	0.00015-0.0055 (0.00030-0.011)	0.0020 (0.0040)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Heptane	4	B	0-0.0014 (0-0.0029)	0.00036 (0.00072)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1-Pentene	4	B	0-0.00066 (0-0.0013)	0.00016 (0.00033)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2-Methyl-2-butene	4	B	0-0.0012 (0-0.0023)	0.00055 (0.0011)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	TOC as propane	8	A	0.0088-0.028 (0.018-0.057)	0.018 (0.036)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Filterable PM	4	A	0.00067-0.025 (0.0013-0.051)	0.0073 (0.015)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Antimony	4	A	0-1.6E-08 (0-3.2E-08)	4.2E-09 (8.3E-09)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Arsenic	4	A	0-1.5E-07 (0-3.0E-07)	5.2E-08 (1.0E-07)	339

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Recycled No. 2 fuel oil	23[d]	Barium	4	A	5.1E-07-1.2E-05 (1.0E-06-2.5E-05)	3.8E-06 (7.5E-06)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Beryllium	4	B	0-0 (0-0)	0 (0)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Cadmium	4	A	0-7.7E-08 (0-1.5E-07)	4.9E-08 (9.8E-08)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Chromium	4	A	2.2E-09-3.6E-07 (4.3E-09-7.2E-07)	1.0E-07 (2.1E-07)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Cobalt	4	B	0-1.0E-07 (0-2.0E-07)	2.6E-08 (5.1E-08)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Copper	4	A	6.8E-08-1.0E-06 (1.4E-07-2.0E-06)	3.7E-07 (7.5E-07)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Lead	4	A	9.1E-08-4.6E-06 (1.8E-07-9.3E-06)	1.6E-06 (3.2E-06)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Manganese	4	A	6.0E-07-1.2E-05 (1.2E-06-2.3E-05)	4.2E-06 (8.4E-06)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Mercury	4	A	7.7E-08-6.6E-07 (1.5E-07-1.3E-06)	2.4E-07 (4.8E-07)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Nickel	4	A	1.9E-08-2.1E-07 (3.8E-08-4.3E-07)	1.1E-07 (2.1E-07)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Phosphorus	4	A	3.6E-06-2.2E-05 (7.3E-06-4.5E-05)	8.5E-06 (1.7E-05)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Silver	4	B	0-2.6E-08 (0-5.3E-08)	6.6E-09 (1.3E-08)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Selenium	4	A	0-4.0E-07 (0-8.1E-07)	1.1E-07 (2.2E-07)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Thallium	4	B	0-9.8E-09 (0-2.0E-08)	4.1E-09 (8.2E-09)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Zinc	4	A	1.2E-06-7.9E-06 (2.4E-06-1.6E-05)	3.1E-06 (6.3E-06)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2,3,7,8-TCDD	4	B	9.3E-14-1.3E-13 (1.9E-13-2.6E-13)	1.1E-13 (2.1E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total TCDD	4	A	3.7E-13-6.2E-13 (7.4E-13-1.2E-12)	4.7E-13 (9.3E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,7,8-PeCDD	4	B	1.3E-13-2.2E-13 (2.5E-13-4.3E-13)	1.6E-13 (3.1E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total PeCDD	4	A	5.3E-13-2.5E-12 (1.1E-12-5.0E-12)	1.3E-12 (2.6E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,4,7,8-HxCDD	4	B	1.6E-13-3.4E-13 (3.1E-13-6.9E-13)	2.1E-13 (4.2E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,6,7,8-HxCDD	4	B	4.8E-13-8.6E-13 (9.6E-13-1.7E-12)	6.5E-13 (1.3E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,7,8,9-HxCDD	4	B	1.3E-13-1.2E-12 (2.7E-13-2.5E-12)	4.9E-13 (9.8E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total HxCDD	4	B	2.5E-12-7.5E-12 (5.0E-12-1.5E-11)	5.0E-12 (1.0E-11)	339

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,4,6,7,8-HpCDD	4	B	1.2E-12-3.7E-12 (2.5E-13-7.4E-12)	2.4E-12 (4.8E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total HpCDD	4	B	1.2E-12-6.2E-12 (2.5E-12-1.2E-11)	3.4E-12 (6.9E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Octa CDD	4	A	4.8E-12-3.3E-11 (9.5E-12-6.6E-11)	1.2E-11 (2.5E-11)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total PCDD	4	B	1.3E-11-5.5E-11 (2.6E-11-1.1E-10)	2.3E-11 (4.5E-11)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2,3,7,8-TCDF	4	B	1.8E-13-8.6E-13 (3.5E-13-1.7E-12)	4.6E-13 (9.2E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total TCDF	4	B	1.2E-12-1.9E-12 (2.5E-12-3.7E-12)	1.5E-12 (3.0E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,7,8-PeCDF	4	B	8.0E-14-3.7E-13 (1.6E-13-7.4E-13)	2.1E-13 (4.2E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2,3,4,7,8-PeCDF	4	B	9.3E-14-6.2E-13 (1.9E-13-1.1E-12)	4.2E-13 (8.4E-13)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total PeCDF	4	B	9.3E-14-3.1E-12 (1.9E-13-6.2E-12)	1.6E-12 (3.2E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,4,7,8-HxCDF	4	A	1.2E-12-2.6E-12 (2.5E-12-5.2E-12)	2.0E-12 (4.0E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,6,7,8-HxCDF	4	A	3.1E-13-8.6E-13 (6.2E-13-1.7E-12)	5.8E-13 (1.2E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	2,3,4,6,7,8-HxCDF	4	A	5.6E-13-1.2E-12 (1.3E-12-2.5E-12)	9.5E-13 (1.9E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,7,8,9-HxCDF	4	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total HxCDF	4	B	3.4E-12-7.5E-12 (6.9E-12-1.5E-11)	5.7E-12 (1.1E-11)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,4,6,7,8-HpCDF	4	A	2.2E-12-4.3E-12 (4.4E-12-8.7E-12)	3.3E-12 (6.5E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	1,2,3,4,7,8,9-HpCDF	4	A	6.2E-13-2.5E-12 (1.2E-12-5.0E-12)	1.4E-12 (2.7E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total HpCDF	4	A	2.5E-12-4.8E-12 (5.0E-12-9.6E-12)	3.7E-12 (7.4E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Octa CDF	4	A	1.9E-12-2.7E-12 (3.7E-12-5.3E-12)	2.4E-12 (4.8E-12)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total PCDF	4	B	1.0E-11-1.8E-11 (2.1E-11-3.5E-11)	1.5E-11 (3.0E-11)	339
Fabric filter	Recycled No. 2 fuel oil	23[d]	Total PCDD/PCDF	4	B	2.2E-11-6.7E-11 (4.3E-11-1.3E-10)	3.7E-11 (7.5E-11)	339
Fabric filter[b]	No. 2 fuel oil	18[e]	Toluene	3	B	0-0.0088 (0-0.018)	0.0037 (0.0074)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	Hexane	3	B	0-0 (0-0)	0 (0)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	Ethylene	3	A	0.0017-0.0051 (0.0035-0.010)	0.0033 (0.0066)	340

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[b]	No. 2 fuel oil	18[e]	Methane	3	A	0.0012-0.0024 (0.0025-0.0047)	0.0018 (0.0036)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	SO_2	3	A	0.0089-0.016 (0.018-0.032)	0.013 (0.026)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	CO	3	A	0.018-0.070 (0.035-0.14)	0.041 (0.083)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	Formaldehyde	3	B	0-0.0024 (0-0.0049)	0.0010 (0.0021)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	3-Methylpentane	3	B	0-0.00033 (0-0.00066)	0.00011 (0.00022)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	Isooctane	3	B	0-7.2E-05 (0-0.00014)	2.4E-05 (4.8E-05)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	Heptane	3	A	0.0077-0.0095 (0.015-0.019)	0.0089 (0.018)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	1-Pentene	3	A	0.0011-0.0033 (0.0023-0.0066)	0.0021 (0.0041)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	2-Methyl-2-butene	3	B	0-9.2E-05 (0-0.00018)	3.1E-05 (6.1E-05)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	n-Pentane	3	B	0-0.00031 (0-0.00062)	0.00010 (0.00021)	340
Fabric filter[b]	No. 2 fuel oil	18[e]	TOC as propane	6	A	0.019-0.040 (0.038-0.079)	0.026 (0.053)	340
None	No. 2 fuel oil	18[e]	Filterable PM	3	A	21-54 (41-108)	36 (73)	340
None	No. 2 fuel oil	18[e]	Antimony	3	B	0-0 (0-0)	0 (0)	340
None	No. 2 fuel oil	18[e]	Arsenic	3	A	5.0E-07-7.6E-07 (1.0E-06-1.5E-06)	6.4E-07 (1.3E-06)	340
None	No. 2 fuel oil	18[e]	Barium	3	A	9.7E-05-1.6E-04 (1.9E-04-3.3E-04)	1.3E-04 (2.5E-04)	340
None	No. 2 fuel oil	18[e]	Beryllium	3	B	0-0 (0-0)	0 (0)	340
None	No. 2 fuel oil	18[e]	Cadmium	3	A	1.3E-06-3.0E-06 (2.6E-06-6.1E-06)	2.1E-06 (4.2E-06)	340
None	No. 2 fuel oil	18[e]	Chromium	3	A	1.0E-05-1.4E-05 (2.0E-05-2.9E-05)	1.2E-05 (2.4E-05)	340
None	No. 2 fuel oil	18[e]	Cobalt	3	A	6.0E-06-9.5E-06 (1.2E-05-1.9E-05)	7.6E-06 (1.5E-05)	340
None	No. 2 fuel oil	18[e]	Copper	3	A	8.0E-05-9.2E-05 (0.00016-0.00018)	8.6E-05 (0.00017)	340
None	No. 2 fuel oil	18[e]	Lead	3	A	1.1E-05-1.3E-05 (2.2E-05-2.6E-05)	1.2E-05 (2.3E-05)	340
None	No. 2 fuel oil	18[e]	Manganese	3	A	0.00030-0.00037 (0.00060-0.00075)	0.00033 (0.00065)	340
None	No. 2 fuel oil	18[e]	Mercury	3	B	0-0 (0-0)	0 (0)	340

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	No. 2 fuel oil	18[e]	Nickel	3	A	6.7E-06-8.9E-06 (1.3E-05-1.8E-05)	7.7E-06 (1.5E-05)	340
None	No. 2 fuel oil	18[e]	Phosphorus	3	A	0.00050-0.00066 (0.0010-0.0013)	0.00060 (0.0012)	340
None	No. 2 fuel oil	18[e]	Silver	3	A	8.9E-08-1.8E-07 (1.8E-07-3.6E-07)	1.3E-07 (2.7E-07)	340
None	No. 2 fuel oil	18[e]	Selenium	3	B	0-1.2E-07 (0-2.5E-07)	5.8E-08 (1.2E-07)	340
None	No. 2 fuel oil	18[e]	Thallium	3	A	2.8E-07-1.8E-06 (5.5E-07-3.7E-06)	1.1E-06 (2.2E-06)	340
None	No. 2 fuel oil	18[e]	Zinc	3	A	7.3E-05-0.00011(0.00015-0.00023)	9.2E-05 (0.00018)	340
Fabric filter	No. 2 fuel oil	18[e]	Filterable PM	3	A	0.0045-0.0094 (0.0089-0.019)	0.0062 (0.012)	340
Fabric filter	No. 2 fuel oil	18[e]	Antimony	3	A	1.6E-07-2.1E-07 (3.1E-07-4.2E-07)	1.8E-07 (3.5E-07)	340
Fabric filter	No. 2 fuel oil	18[e]	Arsenic	3	B	0-0 (0-0)	0 (0)	340
Fabric filter	No. 2 fuel oil	18[e]	Barium	3	A	1.9E-06-3.7E-06 (3.7E-06-7.4E-06)	2.6E-06 (5.2E-06)	340
Fabric filter	No. 2 fuel oil	18[e]	Beryllium	3	B	0-0 (0-0)	0 (0)	340
Fabric filter	No. 2 fuel oil	18[e]	Cadmium	3	A	1.0E-08-1.9E-08 (2.1E-08-3.9E-08)	1.5E-08 (3.1E-08)	340
Fabric filter	No. 2 fuel oil	18[e]	Chromium	3	A	5.0E-07-6.7E-07 (1.0E-06-1.3E-06)	5.7E-07 (1.1E-06)	340
Fabric filter	No. 2 fuel oil	18[e]	Cobalt	3	B	0-0 (0-0)	0 (0)	340
Fabric filter	No. 2 fuel oil	18[e]	Copper	3	A	3.2E-07-8.0E-07 (6.5E-07-1.6E-06)	5.0E-07 (1.0E-06)	340
Fabric filter	No. 2 fuel oil	18[e]	Lead	3	A	2.4E-07-3.5E-07 (4.8E-07-7.0E-07)	3.0E-07 (6.1E-07)	340
Fabric filter	No. 2 fuel oil	18[e]	Manganese	3	A	2.8E-06-6.2E-06 (5.7E-06-1.2E-05)	4.1E-06 (8.3E-06)	340
Fabric filter	No. 2 fuel oil	18[e]	Mercury	3	B	0-0 (0-0)	0 (0)	340
Fabric filter	No. 2 fuel oil	18[e]	Nickel	3	A	2.9E-07-4.3E-07 (5.9E-07-8.6E-07)	3.7E-07 (7.4E-07)	340
Fabric filter	No. 2 fuel oil	18[e]	Phosphorus	3	A	4.5E-06-7.7E-06 (8.9E-06-1.5E-05)	5.8E-06 (1.2E-05)	340
Fabric filter	No. 2 fuel oil	18[e]	Silver	3	B	0-1.5E-08 (0-3.1E-08)	8.4E-09 (1.7E-08)	340
Fabric filter	No. 2 fuel oil	18[e]	Selenium	3	A	2.1E-07-2.6E-07 (4.2E-07-5.2E-07)	2.3E-07 (4.7E-07)	340
Fabric filter	No. 2 fuel oil	18[e]	Thallium	3	B	0-0 (0-0)	0 (0)	340

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	18[e]	Zinc	3	A	1.2E-06-1.8E-06 (2.3E-06-3.6E-06)	1.6E-06 (3.1E-06)	340
Fabric filter	No. 2 fuel oil	18[e]	2,3,7,8-TCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total TCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total PeCDD	3	B	2.6E-13-4.3E-11(5.3E-13-8.7E-11)	2.1E-11 (4.2E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total HxCDD	3	B	5.3E-13-1.9E-11 (1.1E-12-3.8E-11)	7.1E-12 (1.4E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total HpCDD	3	B	7.9E-13-4.3E-11 (1.6E-12-8.7E-11)	1.6E-11 (3.2E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	Octa CDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total PCDD	3	B	1.6E-12-1.1E-10 (3.2E-12-2.1E-10)	4.4E-11 (8.8E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	2,3,7,8-TCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total TCDF	3	B	1.6E-13-5.6E-12 (3.1E-13-1.1E-11)	2.2E-12 (4.5E-12)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDF	3	B	2.6E-13-1.0E-11 (5.3E-13-2.1E-11)	4.1E-12 (8.2E-12)	340
Fabric filter	No. 2 fuel oil	18[e]	2,3,4,7,8-PeCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total PeCDF	3	B	1.1E-12-1.8E-11 (2.1E-12-3.5E-11)	9.4E-12 (1.9E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	2,3,4,6,7,8-HxCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDF	3	B	2.6E-13-1.0E-11 (5.3E-13-2.1E-11)	4.2E-12 (8.4E-12)	340
Fabric filter	No. 2 fuel oil	18[e]	Total HxCDF	3	B	2.6E-13-2.0E-11 (5.3E-13-4.0E-11)	7.3E-12 (1.5E-11)	340

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	1,2,3,4,7,8,9-HpCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total HpCDF	3	B	5.3E-13-1.6E-11 (1.1E-12-3.1E-11)	6.6E-12 (1.3E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	Octa CDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
Fabric filter	No. 2 fuel oil	18[e]	Total PCDF	3	B	2.0E-12-5.4E-11 (4.0E-12-1.1E-10)	2.5E-11 (5.1E-11)	340
Fabric filter	No. 2 fuel oil	18[e]	Total PCDD+PCDF	3	B	3.6E-12-1.6E-10 (7.1E-12-3.2E-10)	7.0E-11 (1.4E-10)	340
None	No. 2 fuel oil	18[e]	2,3,7,8-TCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total TCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total PeCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDD	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total HxCDD	3	B	0.0E+00-2.7E-12 (0.0E+00-5.4E-12)	2.7E-12 (5.4E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDD	3	B	0.0E+00-1.7E-11 (0.0E+00-3.4E-11)	1.7E-11 (3.4E-11)	340
None	No. 2 fuel oil	18[e]	Total HpCDD	3	B	0.0E+00-4.6E-11 (0.0E+00-9.2E-11)	3.5E-11 (7.1E-11)	340
None	No. 2 fuel oil	18[e]	Octa CDD	3	B	0.0E+00-2.2E-9 (0.0E+00-4.4E-9)	1.4E-9 (2.7E-9)	340
None	No. 2 fuel oil	18[e]	Total PCDD	3	B	6.5E-10-2.3E-9 (1.3E-9-4.5E-9)	1.4E-9 (2.8E-9)	340
None	No. 2 fuel oil	18[e]	2,3,7,8-TCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total TCDF	3	B	1.3E-12-2.6E-11 (2.7E-12-5.1E-11)	1.7E-11 (3.3E-11)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	2,3,4,7,8-PeCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total PeCDF	3	B	1.3E-12-6.0E-11 (2.7E-12-1.2E-10)	3.7E-11 (7.4E-11)	340

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDF	3	B	0.0E+00-2.7E-12 (0.0E+00-5.4E-12)	2.7E-12 (5.4E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	2,3,4,6,7,8-HxCDF	3	B	0.0E+00-8.1E-13 (0.0E+00-1.6E-12)	8.1E-13 (1.6E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total HxCDF	3	B	0.0E+00-4.0E-12 (0.0E+00-8.1E-12)	4.1E-12 (8.1E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDF	3	B	0.0E+00-5.4E-12 (0.0E+00-1.1E-11)	5.4E-12 (1.1E-11)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8,9-HpCDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total HpCDF	3	B	5.5E-12-3.9E-12 (1.1E-11-7.8E-11)	1.9E-11 (3.8E-11)	340
None	No. 2 fuel oil	18[e]	Octa CDF	3	B	0.0E+00-0.0E+00 (0.0E+00-0.0E+00)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total PCDF	3	B	2.2E-11-1.2E-10 (4.5E-11-2.3E-10)	7.7E-11 (1.5E-10)	340
None	No. 2 fuel oil	18[e]	Total PCDD+PCDF	3	B	7.5E-10-2.3E-9) (1.5E-9-4.6E-9)	1.5E-9 (3.0E-9)	340
Fabric filter	Natural gas	20	Filterable PM	3	A	0.00055-0.00075 (0.0011-0.0015)	0.00062 (0.0012)	341
Fabric filter	Natural gas	20	Formaldehyde	3	A	0.0018-0.00292 (0.0035-0.0058)	0.0024 (0.0047)	341
Fabric filter	Natural gas	20	CO_2	3	A	18.43-19.97 (36.86-39.95)	19 (38)	341
Fabric filter	Natural gas	20	CO	3	A	0.10 - 0.11 (0.20 - 0.22)	0.10 (0.21)	341
Fabric filter	Natural gas	20	NO_x	3	A	0.0080 - 0.0096 (0.016 - 0.019)	0.0087 (0.017)	341
Fabric filter	Natural gas	20	Benzene	3	A	0.00020 - 0.00024 (0.00039 -0.00048)	0.00022 (0.00044)	341
Fabric filter	Natural gas	20	Filterable PM	3	A	0.0011-0.0013 (0.0022-0.0026)	0.0012 (0.0023)	342
Fabric filter	Natural gas	20	Formaldehyde	3	A	0.00088-0.0013 (0.0018-0.0026)	0.0011 (0.0021)	342
Fabric filter	Natural gas	20	CO_2	3	A	15.00-15.64 (30.01-31.27)	15 (31)	342
Fabric filter	Natural gas	20	CO	3	A	0.039 - 0.050 (0.077 - 0.10)	0.043 (0.086)	342
Fabric filter	Natural gas	20	NO_x	3	A	0.010 - 0.014 (0.020 - 0.028)	0.012 (0.023)	342
Fabric filter	Natural gas	20	Benzene	3	A	0.00015 - 0.00023 (0.00030 - 0.00046)	0.00018 (0.00036)	342

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	20	Chlorobenzene	3	A	BDL	BDL	342
Fabric filter	Natural gas	20	Dichlorobenzene	3	A	BDL	BDL	342
Fabric filter	Natural gas	23	Filterable PM	3	A	0.0016-0.0023 (0.0032-0.0046)	0.0019 (0.0038)	343
Fabric filter	Natural gas	23	Formaldehyde	3	A	0.00020-0.00027 (0.00041-0.00054)	0.00023 (0.00046)	343
Fabric filter	Natural gas	23	CO_2	3	A	15.92-19.41 (31.85-38.81)	18 (35)	343
Fabric filter	Drain oil	24	Filterable PM	3	A	0.0075-0.0098 (0.015-0.0196)	0.0083 (0.017)	344
Fabric filter	Drain oil	24	Formaldehyde	3	A	0.00034-0.00054 (0.00067-0.0011)	0.00045 (0.00091)	344
Fabric filter	Drain oil	24	CO_2	3	A	23.50-24.71 (46.99-49.42)	24 (48)	344
Fabric filter	Drain oil	24	CO	3	A	0.027 - 0.032 (0.055 - 0.065)	0.029 (0.059)	344
Fabric filter	Drain oil	24	NO_x	3	A	0.0077 - 0.00091 (0.015 - 0.018)	0.0083 (0.017)	344
Fabric filter	Drain oil	24	Benzene	3	A	5.2 E-05 - 7.0 E-05 (0.00010 - 0.00014)	6.1 E-05 (0.00012)	344
Fabric filter	Drain oil	10	Filterable PM	3	A	0.0020-0.0032 (0.0041-0.0064)	0.0027 (0.0053)	345
Fabric filter	Drain oil	10	CO_2	3	A	19.64-20.36 (39.28-40.72)	20 (40)	345
Fabric filter	Drain oil	10	SO_2	3	A	0.032-0.034 (0.064-0.067)	0.033 (0.066)	345
Fabric filter	Drain oil	10	Benzene	3	A	6.3E-05-9.9E-05 (1.3E-04-2.0E-04)	7.6E-05 (1.5E-04)	345
Fabric filter	Drain oil	10	Chlorobenzene	3	NR	BDL	BDL	345
Fabric filter	Drain oil	10	Dichlorobenzene	3	NR	BDL	BDL	345
Fabric filter	Drain oil	10	Trichlorobenzene	3	NR	BDL	BDL	345
Fabric filter	Drain oil	10	Filterable PM	3	A	0.0037-0.0040 (0.0074-0.0081)	0.0038 (0.0077)	346
Fabric filter	Drain oil	10	CO_2	3	A	16.31-16.73 (32.62-33.45)	17 (33)	346
Fabric filter	Drain oil	10	CO	3	A	0.015 - 0.016 (0.029 - 0.032)	0.015 (0.030)	346
Fabric filter	Drain oil	10	NO_x	3	A	0.0080 - 0.088 (0.016 - 0.018)	0.0084 (0.017)	346
Fabric filter	Drain oil	10	Benzene	3	A	3.9 E-05 - 5.0 E-05 (7.8 E-05 - 0.00010)	4.6 E-05 (9.2 E-05)	346

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Drain oil	0	Filterable PM	3	A	0.0056-0.0078 (0.011-0.016)	0.0064 (0.013)	347
Fabric filter	Drain oil	0	CO_2	3	A	46.79-49.13 (93.57-98.25)	48 (96)	347
Fabric filter	Drain oil	0	Formaldehyde	3	A	0.0012-0.0014 (0.0024-0.0028)	0.0013 (0.0026)	347
Fabric filter	Drain oil	0	CO	3	A	0.048 - 0.057 (0.096 - 0.11)	0.053 (0.11)	347
Fabric filter	Drain oil	0	NO_x	3	A	0.049 - 0.060 (0.098 - 0.12)	0.057 (0.11)	347
Fabric filter	Drain oil	0	Benzene	3	A	0.00012 - 0.00013 (0.00024 - 0.00027)	0.00013 (0.00026)	347
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0034-0.0040 (0.0068-0.0080)	0.0037 (0.0075)	348
Fabric filter	Waste oil	0	CO_2	3	A	14.92-15.95 (29.85-31.90)	16 (31)	348
Fabric filter	Waste oil	0	HCl	3	A	0.00017-0.00028 (0.00034-0.00057)	0.00022 (0.00045)	348
Fabric filter	Waste oil	0	Benzene	3	A	0.00027-0.00042 (0.00053-0.00083)	0.00035 (0.00069)	348
Fabric filter	Waste oil	0	Formaldehyde	3	A	0.00028-0.00029 (0.00056-0.00058)	0.00029 (0.00057)	348
Fabric filter	Waste oil	20	Filterable PM	3	A	0.00092-0.0011 (0.0018-0.0021)	0.0010 (0.0020)	349
Fabric filter	Waste oil	20	Cond. inorganic PM	3	A	0.00067- 0.00084 (0.0013-0.0017)	0.00077 (0.0015)	349
Fabric filter	Waste oil	20	Cond. organic PM	3	A	0.000012-0.00045 (0.00024-0.00089)	0.00030 (0.00059)	349
Fabric filter	Waste oil	20	CO_2	3	A	19.81-20.94 (39.62-41.88)	20 (41)	349
Fabric filter	Waste oil	20	Formaldehyde	3	A	0.00014-0.00055 (0.00028-0.00110)	0.00033 (0.00066)	349
Fabric filter	Waste oil	20	Benzene	3	A	2.5E-05-3.5E-05 (5.0E-05-7.0E-05)	3.2E-05 (6.3E-05)	349
Fabric filter	Drain oil and natural gas	20	Filterable PM	3	A	0.0046-0.0054 (0.0091-0.011)	0.0050 (0.010)	350
Fabric filter	Drain oil and natural gas	20	CO_2	3	A	13.23-14.03 (26.46-28.05)	14 (27)	350
Fabric filter	Drain oil and natural gas	20	SO_2	3	A	0.0027-0.0049 (0.0054-0.0097)	0.0038 (0.0076)	350
Fabric filter	Drain oil and natural gas	20	H_2SO_4	3	A	0.00011-0.00017 (0.00022-0.00035)	0.00014 (0.00028)	350
Fabric filter	Drain oil and natural gas	20	Benzene	3	A	0.00051-0.00057 (0.0010-0.0011)	0.00053 (0.0011)	350
Fabric filter	Drain oil and natural gas	20	Chlorobenzene	3	NR	BDL	BDL	350

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Drain oil and natural gas	20	Dichlorobenzene	3	NR	BDL	BDL	350
Fabric filter	Drain oil and natural gas	20	Trichlorobenzene	3	NR	BDL	BDL	350
Fabric filter	Drain oil	10	Filterable PM	3	A	0.0099-0.011 (0.020-0.022)	0.011 (0.021)	351
Fabric filter	Drain oil	10	CO_2	3	A	19.42-21.59 (38.85-43.18)	21 (41)	351
Fabric filter	Drain oil	10	SO_2	3	A	0.033-0.041 (0.066-0.083)	0.036 (0.073)	351
Fabric filter	Drain oil	10	H_2SO_4	3	A	0.0010-0.0013 (0.0019-0.0025)	0.0011 (0.0023)	351
Fabric filter	Drain oil	10	Benzene	3	A	0.00010-0.00018 (0.00020-0.00037)	0.00015 (0.00029)	351
Fabric filter	Drain oil	10	Chlorobenzene	3	NR	BDL	BDL	351
Fabric filter	Drain oil	10	Dichlorobenzene	3	NR	BDL	BDL	351
Fabric filter	Drain oil	10	Trichlorobenzene	3	NR	BDL	BDL	351
Fabric filter	No. 2 and No. 5 fuel oil	ND	CO_2	2	A	20.89-22.96 (41.78-45.91)	22 (44)	352
Fabric filter	No. 2 and No. 5 fuel oil	ND	NO_x	2	A	0.023-0.045 (0.046-0.090)	0.034 (0.068)	352
Fabric filter	No. 5 fuel oil	ND	CO_2	3	A	14.37-15.61 (28.73-31.23)	15 (30)	353
Fabric filter	No. 5 fuel oil	ND	NO_x	3	A	0.028-0.034 (0.056-0.068)	0.031 (0.062)	353
Fabric filter	Low-sulfur No. 2 fuel oil	ND	Filterable PM	3	A	0.0029-0.0079 (0.0057-0.016)	0.0056 (0.011)	354
Fabric filter	Low-sulfur No. 2 fuel oil	ND	NO_x	3	A	0.031-0.044 (0.062-0.088)	0.038 (0.076)	354
Fabric filter	Low-sulfur No. 2 fuel oil	ND	CO_2	3	A	20-24 (41-48)	22 (45)	354
Fabric filter	Natural gas	0	CO	2	B	0.0030-0.012 (0.0060-0.023)	0.0070 (0.014)	355
Fabric filter	Natural gas	0	Propane	2	B	0-0.00070 (0-0.0014)	0.00036 (0.00071)	355
Fabric filter	Natural gas	0	Methane	2	B	0.0027-0.0055 (0.0054-0.011)	0.00040 (0.00080)	355
Fabric filter	Natural gas	0	TOC	2	B	0.0034-0.0040 (0.0067-0.0080)	0.0037 (0.0073)	355
Fabric filter	Drain oil	24	Filterable PM	3	A	0.0038 - 0.0063 (0.0076 - 0.013)	0.0050 (0.0099)	371
Fabric filter	Drain oil	24	SO_2	3	A	0.028 - 0.031 (0.056 - 0.063)	0.030 (0.059)	371

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Drain oil	24	Formaldehyde	3	A	0.0046 - 0.0056 (0.0092 - 0.011)	0.0052 (0.010)	371
Fabric filter	Drain oil	24	CO_2	3	A	15 - 16 (30 - 31)	15 (31)	371
Fabric filter	Drain oil	25	Filterable PM	3	A	0.0021 - 0.0028 (0.0043 - 0.0056)	0.0025 (0.0050)	372
Fabric filter	Drain oil	25	SO_2	3	A	0.0037 - 0.0046 (0.0075 - 0.0092)	0.0040 (0.0081)	372
Fabric filter	Drain oil	25	Formaldehyde	3	A	0.0046 - 0.0092 (0.0092 - 0.018)	0.0071 (0.014)	372
Fabric filter	Drain oil	25	CO_2	3	A	18 - 20 (36 - 39)	19 (38)	372
Fabric filter	Drain oil	25	Filterable PM	3	A	0.00078 - 0.00094 (0.0016 - 0.0019)	0.00087 (0.0017)	373
Fabric filter	Drain oil	25	SO_2	3	B	0.027 - 0.029 (0.054 - 0.057)	0.028 (0.056)	373
Fabric filter	Drain oil	25	Benzene	3	B	0.00011 - 0.00026 (0.00023 - 0.00051)	0.00019 (0.00038)	373
Fabric filter	Drain oil	25	Formaldehyde	3	A	0.00039 - 0.0014 (0.00078 - 0.0027)	0.00073 (0.0015)	373
Fabric filter	Drain oil	25	CO_2	3	A	16 - 16 (32 - 33)	16 (32)	373
Fabric filter	Drain oil	ND	Filterable PM	3	A	0.0084 - 0.011 (0.017 - 0.023)	0.010 (0.021)	374
Fabric filter	Drain oil	ND	SO_2	3	A	0.014 - 0.015 (0.027 - 0.030)	0.014 (0.028)	374
Fabric filter	Drain oil	ND	HCl	3	A	0.00012 - 0.00019 (0.00024 - 0.00039)	0.00016 (0.00032)	374
Fabric filter	Drain oil	ND	CO_2	3	A	27 - 31 (53 - 61)	29 (59)	374
Fabric filter	Drain oil	20	Filterable PM	3	A	0.0036 - 0.0053 (0.0072 - 0.011)	0.0046 (0.0091)	375
Fabric filter	Drain oil	20	SO_2	3	A	0.026 - 0.028 (0.051 - 0.055)	0.026 (0.053)	375
Fabric filter	Drain oil	20	Formaldehyde	3	A	0.00095 - 0.0014 (0.0019 - 0.0029)	0.0012 (0.0023)	375
Fabric filter	Drain oil	20	CO_2	3	A	19 - 20 (37 - 40)	19 (38)	375
Fabric filter	Drain oil	0	Filterable PM	3	A	0.0050 - 0.0052 (0.010 - 0.010)	0.0051 (0.010)	376
Fabric filter	Drain oil	0	SO_2	3	A	0.0069 - 0.011 (0.014 - 0.023)	0.0097 (0.019)	376
Fabric filter	Drain oil	0	HCl	3	A	1.1E-05 - 2.7E-05 (2.2E-05 - 5.3E-05)	2.0E-05 (3.9E-05)	376
Fabric filter	Drain oil	0	Benzene	3	A	0.00023 - 0.00032 (0.00045 - 0.00063)	0.00028 (0.00056)	376

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Drain oil	0	CO_2	3	A	13 - 13 (25 - 27)	13 (26)	376
Fabric filter	Drain oil	20	Filterable PM	3	A	0.0063 - 0.0080 (0.013 - 0.016)	0.0072 (0.014)	377
Fabric filter	Drain oil	20	SO_2	3	A	0.025 - 0.027 (0.050 - 0.054)	0.026 (0.053)	377
Fabric filter	Drain oil	20	Benzene	3	A	4.4E-05 - 7.3E-05 (8.7E-05 - 0.00015)	6.2E-05 (0.00012)	377
Fabric filter	Drain oil	20	CO_2	3	A	21 - 22 (42 - 45)	22 (43)	377
Fabric filter	Drain oil	15	SO_2	3	A	0.022 - 0.026 (0.044 - 0.051)	0.024 (0.047)	379
Fabric filter	Drain oil	15	CO_2	3	A	21 - 21 (42 - 42)	21 (42)	379
Fabric filter	Drain oil	15	HCl	3	A	1.0E-5 - 3.9E-5 (2.0E-5 - 3.8E-5)	1.9E-5 (3.8E-5)	379
Fabric filter	Drain oil	0	Filterable PM	3	A	0.013 - 0.018 (0.025 - 0.036)	0.015 (0.030)	380
Fabric filter	Drain oil	0	SO_2	3	A	0.030 - 0.036 (0.060 - 0.073)	0.034 (0.068)	380
Fabric filter	Drain oil	0	HCl	3	A	5.5E-05 - 0.00015 (0.00011 -.00031)	8.8E-05 (0.00018)	380
Fabric filter	Drain oil	0	CO_2	3	A	18 - 20 (36 - 40)	19 (38)	380
Fabric filter	Natural gas	15	Filterable PM	3	A	0.0011 - 0.0012 (0.0022 - 0.0025)	0.0012 (0.0023)	383
Fabric filter	Natural gas	15	Benzene	3	A	5.4E-05 - 0.000114 (0.00011 - 0.00028)	0.00011 (0.00022)	383
Fabric filter	Natural gas	15	Formaldehyde	3	A	0.00014 - 0.00017 (0.00027 - 0.00034)	0.00015 (0.00030)	383
Fabric filter	Natural gas	15	CO_2	3	A	18 - 18 (35 - 37)	18 (36)	383
Fabric filter	Natural gas	23	Filterable PM	3	A	0.00055 - 0.00079 (0.0011 - 0.0016)	0.00068 (0.0014)	384
Fabric filter	Natural gas	23	Benzene	3	A	0.00013 - 0.00015 (0.00025 - 0.00030)	0.00014 (0.00027)	384
Fabric filter	Natural gas	23	Formaldehyde	3	A	0.00060 - 0.00075 (0.0012 - 0.0015)	0.00066 (0.0013)	384
Fabric filter	Natural gas	23	CO_2	3	A	11 - 12 (21 - 24)	12 (23)	384
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0066 - 0.0079 (0.13 - 0.16)	0.071 (0.14)	386
Fabric filter	Waste oil	0	SO_2	3	A	0.035 - 0.037 (0.070 - 0.073)	0.036 (0.071)	386
Fabric filter	Waste oil	0	CO_2	3	A	19 - 20 (38 - 40)	20 (39)	386

Table 4-11 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0046 - 0.0048 (0.0092 - 0.0095)	0.0047 (0.0094)	387
Fabric filter	Waste oil	0	CO_2	3	A	23 - 25 (45 - 49)	23 (47)	387
Fabric filter	Waste oil	0	SO_2	3	A	0.029 - 0.031 (0.058 - 0.063)	0.030 (0.061)	387
Fabric filter	Waste oil	0	CO_2	3	A	22 - 23 (44 - 46)	23 (45)	387
Fabric filter	Waste oil	0	SO_2	3	A	0.022 - 0.026 (0.044 - 0.052)	0.024 (0.049)	388
Fabric filter	Waste oil	0	CO_2	3	A	19 - 21 (37 - 42)	20 (40)	388
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0073 - 0.0084 (0.015 - 0.017)	0.0077 (0.015)	388
Fabric filter	Waste oil	0	Condensable inorganic PM	3	A	0.0088 - 0.014 (0.018 - 0.027)	0.011 (0.022)	388
Fabric filter	Waste oil	0	Condensable organic PM	3	A	0.0012 - 0.0019 (0.0023 - 0.0037)	0.0015 (0.0029)	388
Fabric filter	Waste oil	0	CO_2	3	A	19 - 21 (38 - 42)	20 (40)	388
Fabric filter	Waste oil	0	Formaldehyde	3	A	0.00053 - 0.00064 (0.0011 - 0.0013)	0.00059 (0.0012)	388
Fabric filter	Waste oil	0	CO_2	3	A	20 - 21 (40 - 43)	21 (41)	388

ND = no data available, NR = not rated, NA = not applicable, BDL = below detection limit
[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced.
[b] Control device may provide only incidental control.
[c] Average emission factor computed using an assumed detection limit.
[d] Facility processed 23 percent RAP during Runs 1, 2, and 3, and no RAP during Run 4.
[e] Facility processed 18 percent RAP during Runs 1 and 2 and no RAP during Run 3.

Table 4-12. SUMMARY OF TEST DATA FOR HOT MIX ASPHALT PLANTS; BATCH MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Spray tower[b]	ND	0	Filterable PM	ND	C	ND	0.32 (0.65)	1
Centrifugal scrubber[b]	ND	0	Filterable PM	ND	C	ND	0.14 (0.28)	1
Fabric filter[b]	ND	0	Filterable PM	ND	C	ND	0.067 (0.13)	1
Fabric filter[c]	Natural gas	0	Filterable PM	2	C	0.026-0.029 (0.053-0.058)	0.028 (0.055)	1
Fabric filter[d]	No. 2 fuel oil	0	Filterable PM	2	C	0.068-0.074 (0.14-0.15)	0.071 (0.14)	1
Fabric filter[e]	Natural gas	0	Filterable PM	2	C	0.050-0.057 (0.10-0.11)	0.054 (0.11)	1
None	No. 2 fuel oil	0	Filterable PM	ND	D	ND	18 (37)	5
None	No. 2 fuel oil	0	PM-10	ND	D	ND	3.9 (7.8)	5
None	No. 2 fuel oil	0	Filterable PM	ND	D	ND	14 (27)	5
None	No. 2 fuel oil	0	PM-10	ND	D	ND	2.9 (5.9)	5
Fabric filter[f]	No. 2 fuel oil	0	Filterable PM	3	B	0.015-0.024 (0.030-0.048)	0.018 (0.036)	15
Fabric filter[f,g]	No. 2 fuel oil	0	CO_2	3	B	9.2-10 (18-21)	9.4 (19)	15
Venturi scrubber[h]	No. 2 fuel oil	0	Filterable PM	2	C	0.025-0.028 (0.049-0.055)	0.026 (0.052)	15
Venturi scrubber[h]	No. 2 fuel oil	0	Cond. inorganic PM	2	C	0.0080-0.0086 (0.016-0.017)	0.0083 (0.017)	15
Multiple wet scrubbers[i]	ND	0	Total PM	2	C	0.041-0.049 (0.081-0.098)	0.045 (0.089)	15
Multiple wet scrubbers[j]	ND	0	Total PM	2	C	0.0020-0.0070 (0.0040-0.014)	0.0045 (0.0090)	15
Multiple wet scrubbers[g,j]	ND	0	CO_2	2	C	13-14 (27-29)	14 (28)	15
Wet cyclonic scrubber[k]	ND	0	Filterable PM	3	B	0.015-0.026 (0.029-0.052)	0.020 (0.041)	15
Wet cyclone[l]	Natural gas	0	Filterable PM	3	B	0.027-0.047 (0.056-0.094)	0.035 (0.069)	15
Wet cyclone[l]	Natural gas	0	Cond. inorganic PM	2	C	0.00050 (0.0010)	0.00050 (0.0010)	15
Wet cyclone[g,l]	Natural gas	0	CO_2	3	B	15-16 (30-31)	15 (31)	15
Low-energy scrubber[m]	Natural gas	0	Filterable PM	3	B	0.052-0.069 (0.10-0.14)	0.061 (0.12)	15
Low-energy scrubber[m]	Natural gas	0	Cond. inorganic PM	3	B	0.00050-0.0030 (0.0010-0.0060)	0.0017 (0.0033)	15
Low-energy scrubber[g,m]	Natural gas	0	CO_2	3	B	11 (22)	11 (22)	15

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Wet scrubber[n]	Natural gas	0	Filterable PM	2	C	0.060-0.062 (0.12-0.12)	0.061 (0.12)	15
Wet scrubber[n]	Natural gas	0	Cond. inorganic PM	2	C	0.0015-0.0040 (0.0030-0.0080)	0.0030 (0.0060)	15
Wet scrubber[g,n]	Natural gas	0	CO_2	2	C	12-12 (24-25)	12 (24)	15
Fabric filter[g]	Natural gas	0	CO	4	B	0.42-0.57 (0.85-1.1)	0.50 (1.0)	24
Fabric filter[g]	Natural gas	0	NO_x	9	A	0.016-0.027 (0.032-0.054)	0.020 (0.039)	24
Fabric filter[g]	Natural gas	0	CO_2	12	A	26-33 (51-65)	28 (55)	24
Fabric filter[g]	Natural gas	0	TOC as propane	9	A	0.0085-0.014 (0.017-0.028)	0.010 (0.021)	24
Fabric filter[g]	Natural gas	0	Methane[o]	13	B	$8.1x10^{-5}$-0.010 (0.00019-0.020)	0.0021 (0.0042)	24
Fabric filter[g]	Natural gas	0	Benzene[o]	13	B	$7.5x10^{-6}$-$2.9x10^{-4}$ ($1.5x10^{-5}$-$5.7x10^{-4}$)	$9.6x10^{-5}$ (0.00019)	24
Fabric filter[g]	Natural gas	0	Toluene[o]	13	B	$3.3x10^{-7}$-$7.0x10^{-3}$ ($6.6x10^{-7}$-$1.4x10^{-2}$)	0.00099 (0.0020)	24
Fabric filter[g]	Natural gas	0	Ethyl benzene[o]	13	B	$3.9x10^{-7}$-$1.9x10^{-2}$ ($7.7x10^{-7}$-$3.8x10^{-2}$)	0.0028 (0.0057)	24
Fabric filter[g]	Natural gas	0	Xylene[o]	13	B	$1.4x10^{-6}$-$4.2x10^{-2}$ ($2.8x10^{-6}$-$8.4x10^{-2}$)	0.0035 (0.0069)	24
Fabric filter	Natural gas	0	Barium	2	B	$6.4x10^{-7}$-$8.3x10^{-7}$ ($1.3x10^{-6}$-$1.7x10^{-6}$)	$7.3x10^{-7}$ ($1.5x10^{-6}$)	24
Fabric filter	Natural gas	0	Cadmium	2	B	$1.4x10^{-7}$-$2.4x10^{-7}$ ($2.8x10^{-7}$-$4.8x10^{-7}$)	$1.9x10^{-7}$ ($3.8x10^{-7}$)	24
Fabric filter	Natural gas	0	Chromium	2	B	$1.6x10^{-7}$-$7.3x10^{-7}$ ($3.2x10^{-7}$-$1.5x10^{-6}$)	$4.5x10^{-7}$ ($8.9x10^{-7}$)	24
Fabric filter	Natural gas	0	Copper	2	B	$9.6x10^{-7}$-$1.0x10^{-6}$ ($1.9x10^{-6}$-$2.0x10^{-6}$)	$9.9x10^{-7}$ ($2.0x10^{-6}$)	24
Fabric filter	Natural gas	0	Lead	2	B	$1.1x10^{-7}$-$9.5x10^{-7}$ ($2.2x10^{-7}$-$1.9x10^{-6}$)	$5.3x10^{-7}$ ($1.1x10^{-6}$)	24
Fabric filter	Natural gas	0	Manganese	2	B	$6.2x10^{-6}$-$8.0x10^{-6}$ ($1.2x10^{-5}$-$1.6x10^{-5}$)	$7.1x10^{-6}$ ($1.4x10^{-5}$)	24
Fabric filter	Natural gas	0	Nickel	2	B	$1.7x10^{-7}$-$6.3x10^{-6}$ ($3.3x10^{-7}$-$1.3x10^{-5}$)	$3.2x10^{-6}$ ($6.4x10^{-6}$)	24
Fabric filter	Natural gas	0	Zinc	2	B	$2.4x10^{-6}$-$4.0x10^{-6}$ ($4.7x10^{-6}$-$7.9x10^{-6}$)	$3.2x10^{-6}$ ($6.3x10^{-6}$)	24
Fabric filter	Natural gas	0	Filterable PM	3	A	0.002-0.0035 (0.0039-0.0069)	0.0026 (0.0053)	24
Fabric filter	Natural gas	0	PM-10	3	C	0.00081-0.0011 (0.0016-0.0023)	0.0010 (0.0020)	24
Fabric filter	Natural gas	0	Cond. inorganic PM	3	B	0.0014-0.0034 (0.0028-0.0068)	0.0021 (0.0042)	24
Fabric filter	Natural gas	0	Cond. organic PM	2	B	0.00058-0.00065 (0.0012-0.0013)	0.00061 (0.0012)	24

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	2-Methylnaphthalene	3	A	5.0x10^{-5}-6.5x10^{-5} (0.00010-0.00013)	5.8x10^{-5} (0.00012)	24
Fabric filter[g]	Natural gas	0	Acetaldehyde	3	A	0.00025-0.00044 (0.00051-0.00088)	0.00032 (0.00064)	24
Fabric filter[g]	Natural gas	0	Acetone	2	D	0.0012-0.0053 (0.0024-0.011)	0.0032 (0.0064)	24
Fabric filter[g]	Natural gas	0	Benzaldehyde	3	A	5.0x10^{-5}-7.9x10^{-5} (0.00010-0.00016)	6.4x10^{-5} (0.00013)	24
Fabric filter[g]	Natural gas	0	Butyraldehyde/ Isobutyraldehyde	3	A	2.3x10^{-6}-2.8x10^{-5} (4.7x10^{-6}-5.7x10^{-5})	1.5x10^{-5} (3.0x10^{-5})	24
Fabric filter[g]	Natural gas	0	Crotonaldehyde	3	A	7.5x10^{-6}-2.4x10^{-5} (1.5x10^{-5}-4.9x10^{-5})	1.5x10^{-5} (2.9x10^{-5})	24
Fabric filter[g]	Natural gas	0	Formaldehyde	3	A	0.00091-0.0012 (0.0018-0.0023)	0.0010 (0.0021)	24
Fabric filter[g]	Natural gas	0	Hexanal	3	A	7.5x10^{-6}-1.6x10^{-5} (1.5x10^{-5}-3.2x10^{-5})	1.2x10^{-5} (2.4x10^{-5})	24
Fabric filter[g]	Natural gas	0	Quinone	3	A	7.0x10^{-6}-0.00039 (1.4x10^{-5}-0.00078)	0.00014 (0.00027)	24
Fabric filter[g]	Natural gas	0	CO	3	B	0.027-0.075 (0.053-0.15)	0.055 (0.11)	34
Fabric filter[g]	Natural gas	0	NO_x	3	B	0.010-0.016 (0.020-0.031)	0.013 (0.026)	34
Fabric filter	Natural gas	0	Acenaphthene	3	B	8.5x10^{-10}-4.4x10^{-7} (1.7x10^{-9}-8.7x10^{-7})	2.9x10^{-7} (5.7x10^{-7})	34
Fabric filter	Natural gas	0	Acenaphthylene	3	B	8.5x10^{-10}-3.2x10^{-7} (1.7x10^{-9}-6.3x10^{-7})	1.6x10^{-7} (3.2x10^{-7})	34
Fabric filter	Natural gas	0	Anthracene	3	B	1.7x10^{-9}-9.5x10^{-8} (3.3x10^{-9}-1.9x10^{-7})	4.4x10^{-8} (8.8x10^{-8})	34
Fabric filter	Natural gas	0	Benzo(b)fluoranthene	3	C	1.7x10^{-9}-3.0x10^{-8} (3.3x10^{-9}-6.0x10^{-8})	1.1x10^{-8} (2.2x10^{-8})	34
Fabric filter	Natural gas	0	Benzo(k)fluoranthene	3	C	8.5x10^{-10}-3.4x10^{-8} (1.7x10^{-9}-6.7x10^{-8})	1.2x10^{-8} (2.4x10^{-8})	34
Fabric filter	Natural gas	0	Fluoranthene	3	B	3.4x10^{-9}-3.4x10^{-8} (6.7x10^{-9}-6.7x10^{-8})	2.2x10^{-8} (4.4x10^{-8})	34
Fabric filter	Natural gas	0	Fluorene	3	B	8.5x10^{-10}-6.5x10^{-7} (1.7x10^{-9}-1.3x10^{-6})	3.3x10^{-7} (6.5x10^{-7})	34
Fabric filter	Natural gas	0	Naphthalene	3	B	8.5x10^{-10}-1.6x10^{-5} (1.7x10^{-9}-3.2x10^{-5})	9.5x10^{-6} (1.9x10^{-5})	34
Fabric filter	Natural gas	0	Phenanthrene	3	B	6.0x10^{-7}-1.6x10^{-6} (1.2x10^{-6}-3.1x10^{-6})	1.0x10^{-6} (2.0x10^{-6})	34
Fabric filter	Natural gas	0	Pyrene	3	B	1.7x10^{-9}-3.5x10^{-8} (3.3x10^{-9}-7.0x10^{-8})	2.4x10^{-8} (4.8x10^{-8})	34
Fabric filter[g]	Natural gas	0	Benzene	3	C	1.9x10^{-5}-6.0x10^{-5} (3.7x10^{-5}-0.00012)	3.5x10^{-5} (7.0x10^{-5})	34
Fabric filter[g]	Natural gas	0	Toluene	3	C	2.5x10^{-5}-5.5x10^{-5} (5.0x10^{-5}-0.00011)	3.7x10^{-5} (7.3x10^{-5})	34
Fabric filter[g]	Natural gas	0	Formaldehyde	3	C	2.5x10^{-5}-5.5x10^{-5} (5.0x10^{-5}-0.00011)	3.8x10^{-5} (7.6x10^{-5})	34

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[g]	Natural gas	0	Acetaldehyde	2	C	$5.5x10^{-8}$-$1.2x10^{-6}$ ($1.1x10^{-7}$-$2.3x10^{-6}$)	$6.0x10^{-7}$ ($1.2x10^{-6}$)	34
Fabric filter	Natural gas	0	Arsenic	3	C	$1.6x10^{-8}$-$4.7x10^{-7}$ ($3.2x10^{-8}$-$9.3x10^{-7}$)	$1.7x10^{-7}$ ($3.3x10^{-7}$)	34
Fabric filter	Natural gas	0	Beryllium	3	C	$1.0x10^{-8}$-$1.7x10^{-7}$ ($2.0x10^{-8}$-$3.3x10^{-7}$)	$1.1x10^{-7}$ ($2.2x10^{-7}$)	34
Fabric filter	Natural gas	0	Cadmium	3	B	$3.5x10^{-7}$-$1.2x10^{-6}$ ($7.0x10^{-7}$-$2.3x10^{-6}$)	$6.5x10^{-7}$ ($1.3x10^{-6}$)	34
Fabric filter	Natural gas	0	Chromium	3	C	$1.2x10^{-7}$-$1.7x10^{-7}$ ($2.3x10^{-7}$-$3.3x10^{-7}$)	$1.5x10^{-7}$ ($3.0x10^{-7}$)	34
Fabric filter	Natural gas	0	Hexavalent chromium	3	C	$4.2x10^{-10}$-$1.4x10^{-8}$ ($8.3x10^{-10}$-$2.7x10^{-8}$)	$4.9x10^{-9}$ ($9.7x10^{-9}$)	34
Fabric filter	Natural gas	0	Copper	3	B	$9.0x10^{-7}$-$5.5x10^{-6}$ ($1.8x10^{-6}$-$1.1x10^{-5}$)	$2.7x10^{-6}$ ($5.3x10^{-6}$)	34
Fabric filter	Natural gas	0	Mercury	3	B	$1.2x10^{-8}$-$4.9x10^{-7}$ ($2.3x10^{-8}$-$9.7x10^{-7}$)	$2.3x10^{-7}$ ($4.5x10^{-7}$)	34
Fabric filter	Natural gas	0	Manganese	3	B	$1.2x10^{-6}$-$5.5x10^{-6}$ ($2.4x10^{-6}$-$1.1x10^{-5}$)	$2.9x10^{-6}$ ($5.8x10^{-6}$)	34
Fabric filter	Natural gas	0	Nickel	3	B	$1.5x10^{-7}$-$2.5x10^{-6}$ ($3.0x10^{-7}$-$5.0x10^{-6}$)	$1.0x10^{-6}$ ($2.0x10^{-6}$)	34
Fabric filter	Natural gas	0	Lead	3	B	$1.2x10^{-8}$-$3.4x10^{-7}$ ($2.3x10^{-8}$-$6.7x10^{-7}$)	$1.9x10^{-7}$ ($3.7x10^{-7}$)	34
Fabric filter	Natural gas	0	Selenium	3	C	$2.5x10^{-8}$-$6.5x10^{-8}$ ($5.0x10^{-8}$-$1.3x10^{-7}$)	$4.6x10^{-8}$ ($9.2x10^{-8}$)	34
Fabric filter	Natural gas	0	Zinc	3	B	$1.3x10^{-6}$-$8.0x10^{-6}$ ($2.6x10^{-6}$-$1.6x10^{-5}$)	$3.7x10^{-6}$ ($7.3x10^{-6}$)	34
Wet scrubber	No. 2 fuel oil	0	Total PM	3	C	0.20-0.22 (0.40-0.45)	0.21 (0.43)	40
Wet scrubber[g]	No. 2 fuel oil	0	Formaldehyde	3	D	0.0063-0.010 (0.013-0.020)	0.0078 (0.016)	40
Wet scrubber	ND	0	Total PM	3	C	0.32-0.40 (0.65-0.80)	0.37 (0.75)	40
Wet scrubber[g]	ND	0	Formaldehyde	3	D	0.0019-0.0021 (0.0037-0.0043)	0.0020 (0.0040)	40
Wet scrubber	No. 2 fuel oil	0	Total PM	3	C	0.027-0.032 (0.054-0.064)	0.029 (0.058)	40
Wet scrubber[g]	No. 2 fuel oil	0	Formaldehyde	3	D	0.00050-0.00055 (0.0010-0.0011)	0.00053 (0.0011)	40
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	C	0.0024-0.0030 (0.0047-0.0060)	0.0026 (0.0053)	40
Fabric filter[g]	No. 2 fuel oil	0	Formaldehyde	3	D	$7.9x10^{-5}$-0.00011 (0.00016-0.00021)	0.00010 (0.00019)	40
Fabric filter	Waste oil	0	Filterable PM	3	C	0.0025-0.0030 (0.0049-0.0061)	0.0027 (0.0054)	40
Fabric filter[g]	Waste oil	0	Formaldehyde	3	D	0.00076-0.00099 (0.0015-0.0020)	0.00088 (0.0018)	40
Fabric filter	Waste oil	0	Total PM	3	C	0.036-0.043 (0.073-0.085)	0.039 (0.078)	40

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter[g]	Waste oil	0	Formaldehyde	3	D	0.00084-0.0011 (0.0017-0.0021)	0.00097 (0.0019)	40
Fabric filter	Waste oil	30	Total PM	3	C	0.059-0.062 (0.12-0.12)	0.061 (0.12)	40
Fabric filter[g]	Waste oil	30	Formaldehyde	3	D	0.00039-0.00050 (0.00078-0.0010)	0.00044 (0.00089)	40
Fabric filter	ND	0	Filterable PM	3	C	0.018-0.019 (0.036-0.039)	0.019 (0.037)	40
Fabric filter[g]	ND	0	Formaldehyde	3	D	0.0037-0.0049 (0.0073-0.0098)	0.0044 (0.0087)	40
Fabric filter	ND	0	Filterable PM	3	C	0.077-0.12 (0.15-0.24)	0.093 (0.19)	40
Fabric filter[g]	ND	0	Formaldehyde	3	D	0.0029-0.0049 (0.0058-0.0098)	0.0039 (0.0079)	40
Fabric filter	ND	0	Arsenic	3	C	$2.1x10^{-7}$-$1.0x10^{-6}$ ($4.1x10^{-7}$-$2.0x10^{-6}$)	$4.9x10^{-7}$ ($9.9x10^{-7}$)	40
Fabric filter	ND	0	Filterable PM	3	B	0.0014-0.0015 (0.0027-0.0030)	0.0014 (0.0028)	41
Fabric filter[g]	ND	0	CO_2	3	B	15-15 (30-31)	15 (31)	41
Fabric filter[g]	Natural gas	0	CO	3	A	0.012-0.021 (0.023-0.042)	0.017 (0.033)	46
Fabric filter[g]	Natural gas	0	CO_2	3	A	9.4-11 (19-21)	10 (20)	46
Fabric filter[g]	Natural gas	0	SO_2	3	A	0.0011-0.0040 (0.0022-0.0079)	0.0029 (0.0057)	46
Fabric filter[g]	Natural gas	0	NO_x	3	A	0.0057-0.0083 (0.011-0.017)	0.0071 (0.014)	46
Fabric filter[g]	Natural gas	0	TOC as propane	1	C	NA	0.0044 (0.0087)	46
Fabric filter[g]	Natural gas	0	Methane	2	B	0.00041-0.00075 (0.00081-0.0015)	0.00058 (0.0012)	46
Fabric filter[g]	Natural gas	0	Benzene	3	A	$2.4x10^{-5}$-0.00065 ($4.8x10^{-5}$-0.0013)	0.00025 (0.00050)	46
Fabric filter[g]	Natural gas	0	Toluene	3	A	$4.8x10^{-5}$-0.0022 ($9.5x10^{-5}$-0.0044)	0.00076 (0.0015)	46
Fabric filter[g]	Natural gas	0	Ethylbenzene	3	A	$2.4x10^{-5}$-0.0012 ($4.8x10^{-5}$-0.0024)	0.00042 (0.00083)	46
Fabric filter[g]	Natural gas	0	Xylene	3	A	$7.2x10^{-5}$-0.0022 (0.00014-0.0044)	0.00079 (0.0016)	46
Fabric filter	Natural gas	0	Naphthalene	3	A	$2.4x10^{-5}$-$6.5x10^{-5}$ ($4.7x10^{-5}$-$1.3x10^{-4}$)	$4.1x10^{-5}$ ($8.1x10^{-5}$)	46
Fabric filter	Natural gas	0	Acenaphthylene	3	A	$6.1x10^{-7}$-$8.0x10^{-7}$ ($1.2x10^{-6}$-$1.6x10^{-6}$)	$7.0x10^{-7}$ ($1.4x10^{-6}$)	46
Fabric filter	Natural gas	0	Acenaphthene	3	A	$8.0x10^{-7}$-$1.5x10^{-6}$ ($1.6x10^{-6}$-$3.0x10^{-6}$)	$1.0x10^{-6}$ ($2.1x10^{-6}$)	46
Fabric filter	Natural gas	0	Fluorene	3	A	$1.5x10^{-6}$-$2.6x10^{-6}$ ($3.1x10^{-6}$-$5.2x10^{-6}$)	$1.9x10^{-6}$ ($3.8x10^{-6}$)	46

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Phenanthrene	3	A	$2.1x10^{-6}$-$3.7x10^{-6}$ ($4.1x10^{-6}$-$7.5x10^{-6}$)	$2.7x10^{-6}$ ($5.5x10^{-6}$)	46
Fabric filter	Natural gas	0	Anthracene	3	A	$2.0x10^{-7}$-$3.7x10^{-7}$ ($4.0x10^{-7}$-$7.5x10^{-7}$)	$2.7x10^{-7}$ ($5.3x10^{-7}$)	46
Fabric filter	Natural gas	0	Fluoranthene	3	A	$4.1x10^{-8}$-$7.0x10^{-8}$ ($8.2x10^{-8}$-$1.4x10^{-7}$)	$5.3x10^{-8}$ ($1.1x10^{-7}$)	46
Fabric filter	Natural gas	0	Pyrene	3	A	$3.3x10^{-8}$-$5.0x10^{-8}$ ($6.5x10^{-8}$-$1.0x10^{-7}$)	$3.9x10^{-8}$ ($7.8x10^{-8}$)	46
Fabric filter	Natural gas	0	Benzo(a)anthracene	3	A	$1.1x10^{-9}$-$1.8x10^{-9}$ ($2.2x10^{-9}$-$3.5x10^{-9}$)	$1.4x10^{-9}$ ($2.8x10^{-9}$)	46
Fabric filter	Natural gas	0	Chrysene	3	A	$2.4x10^{-9}$-$3.7x10^{-9}$ ($4.8x10^{-9}$-$7.4x10^{-9}$)	$3.1x10^{-9}$ ($6.3x10^{-9}$)	46
Fabric filter	Natural gas	0	Benzo(b)fluoranthene	3	A	$7.0x10^{-10}$-$1.1x10^{-9}$ ($1.4x10^{-9}$-$2.2x10^{-9}$)	$8.8x10^{-10}$ ($1.8x10^{-9}$)	46
Fabric filter[g]	Natural gas	0	Formaldehyde	3	A	$6.2x10^{-5}$-$2.5x10^{-4}$ (0.00012-0.00049)	0.00017 (0.00035)	46
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0014-0.0024 (0.0028-0.0047)	0.0017 (0.0034)	46
Fabric filter	Natural gas	0	Cond. PM	3	B	$3.6x10^{-5}$-0.00085 ($7.2x10^{-5}$-0.0017)	0.00036 (0.00071)	46
Fabric filter[g]	Natural gas	0	CO	8	A	0.041-0.14 (0.082-0.27)	0.095 (0.19)	47
Fabric filter[g]	Natural gas	0	CO_2	8	A	19-22 (39-45)	21 (43)	47
Fabric filter[g]	Natural gas	0	SO_2	8	A	0.00093-0.0028 (0.0019-0.0056)	0.0017 (0.0034)	47
Fabric filter[g]	Natural gas	0	NO_x	8	A	0.0082-0.014 (0.016-0.028)	0.011 (0.022)	47
Fabric filter[g]	Natural gas	0	TOC as propane	8	A	0.0055-0.016 (0.011-0.032)	0.0095 (0.019)	47
Fabric filter[g]	Natural gas	0	Methane	8	A	0.0046-0.017 (0.0092-0.033)	0.0099 (0.020)	47
Fabric filter[g]	Natural gas	0	Benzene[o]	3	C	0.00023-0.00028 (0.00046-0.00056)	0.00026 (0.00052)	47
Fabric filter[g]	Natural gas	0	Toluene[o]	3	C	0.00027-0.00033 (0.00054-0.00066)	0.00030 (0.00061)	47
Fabric filter[g]	Natural gas	0	Ethylbenzene[o]	3	C	0.00031-0.00038 (0.00062-0.00076)	0.00035 (0.00070)	47
Fabric filter[g]	Natural gas	0	Xylene[o]	3	C	0.00031-0.00038 (0.00062-0.00076)	0.00035 (0.00070)	47
Fabric filter	Natural gas	0	Naphthalene	3	A	$1.1x10^{-5}$-$1.4x10^{-5}$ ($2.2x10^{-5}$-$2.7x10^{-5}$)	$1.3x10^{-5}$ ($2.5x10^{-5}$)	47
Fabric filter	Natural gas	0	2-Methylnaphthalene	3	A	$1.5x10^{-5}$-$1.9x10^{-5}$ ($2.9x10^{-5}$-$3.7x10^{-5}$)	$1.6x10^{-5}$ ($3.3x10^{-5}$)	47
Fabric filter	Natural gas	0	Fluorene	3	A	$7.8x10^{-7}$-$1.1x10^{-6}$ ($1.6x10^{-6}$-$2.2x10^{-6}$)	$8.8x10^{-7}$ ($1.8x10^{-6}$)	47
Fabric filter	Natural gas	0	Phenanthrene	3	A	$9.3x10^{-7}$-$1.2x10^{-6}$ ($1.9x10^{-6}$-$2.5x10^{-6}$)	$1.1x10^{-6}$ ($2.2x10^{-6}$)	47

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Fluoranthene	3	A	$1.6x10^{-7}$-$3.1x10^{-7}$ ($3.1x10^{-7}$-$6.2x10^{-7}$)	$2.1x10^{-7}$ ($4.1x10^{-7}$)	47
Fabric filter[g]	Natural gas	0	Formaldehyde	3	A	$3.3x10^{-5}$-$7.9x10^{-5}$ ($6.5x10^{-5}$-$1.6x10^{-4}$)	$6.2x10^{-5}$ ($1.2x10^{-4}$)	47
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0012-0.0026 (0.0023-0.0051)	0.0018 (0.0037)	47
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0011-0.0016 (0.0022-0.0032)	0.0013 (0.0027)	47
Fabric filter	Natural gas	0	Cond. organic PM	2	B	0.0044-0.0046 (0.0088-0.0091)	0.0045 (0.0090)	47
Fabric filter[g]	No. 6 fuel oil	30	CO	9	A	0.019-0.065 (0.038-0.13)	0.035 (0.069)	49
Fabric filter[g]	No. 6 fuel oil	30	CO_2	9	A	25-32 (50-63)	29 (59)	49
Fabric filter[g]	No. 6 fuel oil	30	SO_2	9	A	0.10-0.15 (0.21-0.30)	0.12 (0.24)	49
Fabric filter[g]	No. 6 fuel oil	30	NO_x	9	A	0.068-0.10 (0.14-0.20)	0.084 (0.17)	49
Fabric filter[g]	No. 6 fuel oil	30	TOC as propane	9	A	0.015-0.028 (0.030-0.056)	0.021 (0.043)	49
Fabric filter[g]	No. 6 fuel oil	30	Methane	8	A	0.00013-0.0048 (0.00026-0.0096)	0.0022 (0.0043)	49
Fabric filter[g]	No. 6 fuel oil	30	Benzene[o]	3	C	0.00055-0.00060 (0.0011-0.0012)	0.00057 (0.0011)	49
Fabric filter[g]	No. 6 fuel oil	30	Toluene[o]	3	C	0.00065-0.00070 (0.0013-0.0014)	0.00068 (0.0014)	49
Fabric filter[g]	No. 6 fuel oil	30	Ethylbenzene[o]	3	C	0.00075-0.00080 (0.0015-0.0016)	0.00078 (0.0016)	49
Fabric filter[g]	No. 6 fuel oil	30	Xylene[o]	3	C	0.00075-0.00080 (0.0015-0.0016)	0.00078 (0.0016)	49
Fabric filter	No. 6 fuel oil	30	Naphthalene	3	A	$1.7x10^{-5}$-$2.9x10^{-5}$ ($3.4x10^{-5}$-$5.8x10^{-5}$)	$2.2x10^{-5}$ ($4.5x10^{-5}$)	49
Fabric filter	No. 6 fuel oil	30	2-Methylnaphthalene	3	A	$2.5x10^{-5}$-$3.5x10^{-5}$ ($4.9x10^{-5}$-$6.9x10^{-5}$)	$3.0x10^{-5}$ ($6.0x10^{-5}$)	49
Fabric filter	No. 6 fuel oil	30	Phenanthrene	2	B	$1.3x10^{-5}$-$2.4x10^{-5}$ ($2.6x10^{-5}$-$4.8x10^{-5}$)	$1.9x10^{-5}$ ($3.7x10^{-5}$)	49
Fabric filter	No. 6 fuel oil	30	Fluoranthene	3	A	$5.3x10^{-6}$-$2.4x10^{-5}$ ($1.1x10^{-5}$-$4.8x10^{-5}$)	$1.2x10^{-5}$ ($2.4x10^{-5}$)	49
Fabric filter	No. 6 fuel oil	30	Pyrene	3	A	$7.1x10^{-6}$-$6.7x10^{-5}$ ($1.4x10^{-5}$-$1.3x10^{-4}$)	$2.7x10^{-5}$ ($5.5x10^{-5}$)	49
Fabric filter[g]	No. 6 fuel oil	30	Formaldehyde	3	B	$1.5x10^{-5}$-$1.1x10^{-3}$ ($3.0x10^{-5}$-$2.1x10^{-3}$)	0.00040 (0.00081)	49
Fabric filter	No. 6 fuel oil	30	Filterable PM	3	A	0.040-0.055 (0.079-0.11)	0.045 (0.089)	49
Fabric filter	No. 6 fuel oil	30	Cond. inorganic PM	3	A	0.0049-0.020 (0.0097-0.039)	0.013 (0.026)	49
Fabric filter	No. 6 fuel oil	30	Cond. organic PM	3	A	0.0070-0.012 (0.014-0.024)	0.0091 (0.018)	49

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Wet scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0070-0.025 (0.014-0.051)	0.016 (0.031)	52
Wet scrubber	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.00030-0.00066 (0.00060-0.0013)	0.00050 (0.0010)	52
Wet scrubber	No. 2 fuel oil	0	Cond. organic PM	3	A	0.00096-0.0014 (0.0019-0.0029)	0.0011 (0.0023)	52
Wet scrubber	No. 2 fuel oil	0	CO_2	3	A	11-13 (21-27)	12 (24)	52
Wet scrubber	Waste oil	35	Filterable PM	3	A	0.14-0.17 (0.29-0.33)	0.15 (0.31)	61
Wet scrubber	Natural gas	35	Cond. organic PM	3	A	0.0010-0.0027 (0.0021-0.0054)	0.0016 (0.0032)	61
Wet scrubber	Natural gas	35	CO_2	3	A	14-17 (29-34)	16 (31)	61
Wet scrubber	Natural gas	26	Filterable PM	3	A	0.040-0.051 (0.080-0.10)	0.044 (0.089)	62 (61)
Wet scrubber	Natural gas	26	Cond. organic PM	3	A	0.0033-0.0061 (0.0066-0.012)	0.0048 (0.0095)	62 (61)
Wet scrubber	Natural gas	26	CO_2	3	A	15-19 (30-38)	18 (35)	62 (61)
Venturi scrubber	Propane	0	Filterable PM	3	A	0.012-0.017 (0.024-0.033)	0.014 (0.028)	69
Venturi scrubber	Propane	0	Cond. organic PM	3	A	0.0021-0.0034 (0.0042-0.0068)	0.0026 (0.0051)	69
Venturi scrubber	Propane	0	CO_2	3	A	11-12 (22-24)	11 (23)	69
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0034-0.0034 (0.0068-0.0068)	0.0034 (0.0068)	72
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0012-0.0030 (0.0023-0.0059)	0.0020 (0.0039)	72
Fabric filter	Natural gas	0	CO_2	3	A	15-16 (30-31)	15 (31)	72
Dual wet scrubbers	Natural gas	30	Filterable PM	3	A	0.011-0.013 (0.021-0.027)	0.012 (0.025)	76
Dual wet scrubbers	Natural gas	30	Cond. organic PM	3	A	0.00034-0.0015 (0.00067-0.0030)	0.00091 (0.0018)	76
Dual wet scrubbers	Natural gas	30	CO_2	3	A	11-12 (23-23)	12 (23)	76
Wet scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.059-0.10 (0.12-0.20)	0.078 (0.16)	77
Wet scrubber	No. 6 fuel oil	0	Cond. organic PM	3	A	0.00075-0.00099 (0.0015-0.0020)	0.00090 (0.0018)	77
Wet scrubber	No. 6 fuel oil	0	CO_2	3	A	16-22 (33-43)	19 (39)	77

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 6 fuel oil	26	Filterable PM	3	A	0.0028-0.0051 (0.0057-0.010)	0.0038 (0.0076)	79
Fabric filter	No. 6 fuel oil	26	Cond. organic PM	3	A	0.0012-0.0031 (0.0023-0.0062)	0.0022 (0.0045)	79
Fabric filter	No. 6 fuel oil	26	CO_2	3	A	20-20 (39-41)	20 (40)	79
Wet scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.14-0.21 (0.29-0.42)	0.17 (0.34)	80
Wet scrubber	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0028-0.0078 (0.0055-0.016)	0.0046 (0.0091)	80
Wet scrubber	No. 6 fuel oil	0	CO_2	3	A	21-26 (42-53)	23 (46)	80
Fabric filter	No. 6 fuel oil	15	Filterable PM	3	A	0.0017-0.0022 (0.0033-0.0044)	0.0019 (0.0039)	83
Fabric filter	No. 6 fuel oil	15	Cond. organic PM	3	A	0.0031-0.0036 (0.0061-0.0073)	0.0034 (0.0067)	83
Fabric filter	No. 6 fuel oil	15	CO_2	3	A	18-18 (35-36)	18 (36)	83
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0025-0.011 (0.0050-0.022)	0.0059 (0.012)	86
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0021-0.0034 (0.0042-0.0068)	0.0026 (0.0053)	86
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0026-0.0069 (0.0051-0.014)	0.0040 (0.0081)	86
Fabric filter	Natural gas	0	CO_2	3	B	18-21 (36-42)	19 (38)	86
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0059-0.013 (0.012-0.025)	0.0082 (0.016)	97
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0067-0.0087 (0.013-0.017)	0.0080 (0.016)	97
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0019-0.0020 (0.0037-0.0040)	0.0019 (0.0039)	97
Fabric filter	Natural gas	0	CO_2	3	B	52-53 (100-110)	53 (110)	97
Fabric filter	Coal/propane	0	Filterable PM	3	A	0.0035-0.023 (0.0070-0.047)	0.016 (0.032)	98
Fabric filter	Coal/propane	0	CO_2	3	A	9.5-12 (19-25)	11 (21)	98
Fabric filter	Coal/propane	0	SO_2	3	D	0.0028-0.048 (0.0056-0.095)	0.027 (0.053)	98
Fabric filter	Coal/propane	0	Sulfuric acid	3	D	0.0074-0.018 (0.015-0.035)	0.013 (0.025)	98
Fabric filter	ND	0	Filterable PM	2	C	0.014-0.015 (0.029-0.029)	0.015 (0.029)	100
Fabric filter	ND	0	Cond. inorganic PM	2	C	0.0045-0.0060 (0.0091-0.012)	0.0053 (0.011)	100
Fabric filter	ND	0	CO_2	2	C	13-15 (26-29)	14 (28)	100

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.043-0.058 (0.086-0.12)	0.050 (0.10)	106
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	45-56 (90-110)	45 (91)	106
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0028-0.0036 (0.0055-0.0071)	0.0033 (0.0065)	110
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15-17 (31-33)	16 (32)	110
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.036-0.048 (0.072-0.097)	0.041 (0.082)	111
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	8.7-11 (17-22)	10 (20)	111
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0019-0.0062 (0.0038-0.012)	0.0044 (0.0088)	113
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	7.7-11 (15-21)	8.8 (18)	113
Fabric filter	Coal/propane	0	Filterable PM	3	A	0.020-0.025 (0.041-0.050)	0.023 (0.046)	126
Fabric filter	Coal/propane	0	CO_2	3	B	14-15 (28-30)	15 (29)	126
Fabric filter	Coal/propane	0	SO_2	3	A	0.015-0.031 (0.031-0.063)	0.022 (0.043)	126
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.0028-0.0045 (0.0057-0.0089)	0.0038 (0.0076)	135
Fabric filter	Natural gas	ND	CO_2	3	B	15-17 (30-33)	16 (32)	135
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0060-0.0087 (0.012-0.017)	0.0072 (0.014)	138
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	31-38 (63-76)	34 (69)	138
Scrubber	ND	0	Filterable PM	3	C	0.014-0.021 (0.028-0.042)	0.017 (0.034)	139
Scrubber	ND	0	CO_2	3	C	29-30 (57-59)	29 (58)	139
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	B	0.026-0.030 (0.051-0.060)	0.028 (0.057)	140
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	17-22 (33-45)	19 (37)	140
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.00083-0.0016 (0.0017-0.0032)	0.0012 (0.0024)	143
Fabric filter	No. 6 fuel oil	0	Cond. inorganic PM	3	A	0.00026-0.00051 (0.00051-0.0010)	0.00040 (0.00080)	143
Fabric filter	No. 6 fuel oil	0	Cond. organic PM	3	A	0.00045-0.00079 (0.00089-0.0016)	0.00058 (0.0012)	143
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	18-20 (35-39)	19 (37)	143
Fabric filter	No. 6 fuel oil	0	Formaldehyde	3	D	0.0014-0.0025 (0.0028-0.0051)	0.0019 (0.0038)	143

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.15-0.26 (0.30-0.52)	0.20 (0.40)	145
Venturi scrubber	Natural gas	0	Cond. inorganic PM	3	A	0.00068-0.0012 (0.0014-0.0025)	0.00093 (0.0019)	145
Venturi scrubber	Natural gas	0	Cond. organic PM	3	A	0.00085-0.0018 (0.0017-0.0037)	0.0014 (0.0029)	145
Venturi scrubber	Natural gas	0	CO_2	3	B	19-22 (38-43)	20 (41)	145
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.052-0.059 (0.10-0.12)	0.055 (0.11)	155
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.0050-0.0054 (0.010-0.011)	0.0052 (0.010)	155
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	13-15 (25-30)	14 (28)	155
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.026-0.030 (0.053-0.060)	0.028 (0.057)	161
Fabric filter	No. 2 fuel oil	0	CO	3	A	0.15-0.21 (0.29-0.42)	0.19 (0.37)	161
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	C	3.0-5.2 (6.0-10)	4.0 (8.0)	161
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	42-49 (84-99)	47 (93)	161
Fabric filter	Propane	ND	Filterable PM	2	B	0.011-0.011 (0.021-0.023)	0.011 (0.022)	165
Fabric filter	Propane	ND	Cond. organic PM	2	B	0.00014-0.00042 (0.00027-0.00084)	0.00028 (0.00056)	165
Fabric filter	Propane	ND	Cond. inorganic PM	2	B	0.00049-0.00069 (0.00099-0.0014)	0.00059 (0.0012)	165
Fabric filter	Propane	ND	CO_2	2	B	23-26 (47-53)	25 (50)	165
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.00072-0.023 (0.0014-0.045)	0.014 (0.027)	170
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	A	0-0.012 (0-0.024)	0.0040 (0.0080)	170
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.019-0.062 (0.037-0.12)	0.033 (0.066)	170
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	15-20 (29-39)	16 (32)	170
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.00083-0.0020 (0.0017-0.0039)	0.0014 (0.0027)	181
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.00033-0.00091 (0.00066-0.0018)	0.00061 (0.0012)	181
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	10-20 (20-41)	16 (31)	181
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0023-0.0042 (0.0046-0.0084)	0.0032 (0.0064)	176
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.00084-0.0022 (0.0017-0.0044)	0.0017 (0.0034)	176

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.00035-0.00051 (0.00071-0.0010)	0.00042 (0.00084)	176
Fabric filter	Natural gas	0	CO_2	3	A	17-19 (33-38)	18 (36)	176
Venturi scrubber	No. 4 waste oil	0	Filterable PM	3	C	0.011-0.017 (0.021-0.035)	0.014 (0.027)	177
Venturi scrubber	No. 4 waste oil	0	CO_2	3	C	7.1-12 (14-25)	10 (20)	177
Venturi scrubber	No. 4 waste oil	0	Lead	3	C	$1.3x10^{-6}$-$6.0x10^{-6}$ ($2.7x10^{-6}$-$1.2x10^{-5}$)	$3.1x10^{-6}$ ($6.2x10^{-6}$)	177
Fabric filter	No. 2 fuel	0	Filterable PM	3	A	0.036-0.051 (0.073-0.10)	0.042 (0.085)	184
Fabric filter	No. 2 fuel	0	CO_2	3	A	26-29 (52-58)	28 (55)	184
Fabric filter	No.2 fuel	ND	Filterable PM	2	B	0.0025-0.0032 (0.0050-0.0064)	0.0028 (0.0057)	188
Fabric filter	No.2 fuel oil	ND	CO_2	3	B	16-18 (31-37)	17 (34)	188
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.00096-0.0019 (0.0019-0.0038)	0.0013 (0.0026)	193
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.0027-0.0065 (0.0053-0.013)	0.0040 (0.0080)	193
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	6.1-16 (12-33)	12 (24)	193
Fabric filter	Propane	0	Filterable PM	3	A	0.0051-0.0079 (0.010-0.016)	0.0070 (0.014)	199
Fabric filter	Propane	0	CO_2	3	A	15-15 (29-30)	15 (30)	199
Fabric filter	Reprocessed oil	ND	Filterable PM	3	B	0.053-0.057 (0.11-0.11)	0.056 (0.11)	200
Fabric filter	Reprocessed oil	ND	CO_2	3	B	19-22 (38-43)	20 (40)	200
Fabric filter	Reprocessed oil	0	Filterable PM	3	A	0.0040-0.0064 (0.0081-0.013)	0.0049 (0.0099)	201
Fabric filter	Reprocessed oil	0	CO_2	3	A	18-20 (37-40)	19 (38)	201
Fabric filter	ND	0	Filterable PM	3	C	0.0027-0.0035 (0.0053-0.0070)	0.0032 (0.0064)	202
Fabric filter	ND	0	CO_2	3	C	14-18 (29-36)	16 (31)	202
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0048-0.0060 (0.0096-0.012)	0.0054 (0.011)	203
Fabric filter	Natural gas	ND	CO_2	3	A	9.8-10 (20-20)	10 (20)	203

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0041-0.0047 (0.0082-0.0093)	0.0043 (0.0086)	204
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	18-19 (36-38)	18 (37)	204
Fabric filter	No. 2 fuel oil	ND	CO	3	B	0.51-0.74 (1.0-1.5)	0.65 (1.3)	204
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.014-0.021 (0.028-0.042)	0.016 (0.033)	213
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	B	0.0023-0.0086 (0.0046-0.017)	0.0061 (0.012)	213
Fabric filter	Natural gas	ND	CO_2	3	B	18-23 (37-46)	20 (41)	213
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.013-0.016 (0.027-0.032)	0.015 (0.029)	215
Fabric filter	Natural gas	ND	CO_2	3	B	14-15 (28-30)	15 (29)	215
Fabric filter	Natural gas	ND	CO	3	C	0.39-0.42 (0.79-0.85)	0.41 (0.82)	215
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.028-0.033 (0.055-0.065)	0.030 (0.061)	216
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	B	0.063-0.068 (0.13-0.14)	0.065 (0.13)	216
Fabric filter	Natural gas	ND	CO_2	3	B	20-25 (39-51)	22 (44)	216
Fabric filter	Natural gas	ND	CO	3	B	0.70-0.82 (1.4-1.7)	0.78 (1.6)	216
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.21-0.23 (0.41-0.47)	0.22 (0.43)	217
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	B	0.051-0.057 (1.0E-1-1.1E-1)	0.053 (0.11)	217
Fabric filter	Natural gas	ND	CO_2	3	B	15-16 (29-31)	15 (30)	217
Fabric filter	Natural gas	ND	CO	3	B	0.61-0.61 (1.2-1.2)	0.61 (1.2)	217
Fabric filter	Coal/ liquid propane	0	Filterable PM	3	A	0.0074-0.0086 (0.015-0.017)	0.0080 (0.016)	219
Fabric filter	Coal/ liquid propane	0	CO_2	3	A	6.1-8.7 (12-17)	6.8 (14)	219
Fabric filter	Propane	ND	Filterable PM	3	A	0.0024-0.0071 (0.0049-0.014)	0.0043 (0.0086)	220
Fabric filter	Propane	ND	CO_2	3	A	17-23 (33-47)	19 (39)	220
Fabric filter	Natural gas	22	Filterable PM	1	C	NA	0.018 (0.036)	222
Fabric filter	Natural gas	22	CO_2	3	C	0.29-5.1 (0.59-10)	3.4 (6.9)	222

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0038-0.0049 (0.0075-0.0097)	0.0044 (0.0088)	224
Fabric filter	Natural gas	0	CO_2	3	A	75-79 (150-160)	78 (160)	224
Fabric filter	Propane	0	Filterable PM	3	A	0.0032-0.0045 (0.0065-0.0089)	0.0039 (0.0079)	225
Fabric filter	Propane	0	CO_2	3	A	52-54 (100-110)	53 (110)	225
Fabric filter	Natural gas	0	CO_2	1	C	NA	13 (25)	231
Fabric filter	Natural gas	0	CO_2	1	C	NA	14 (28)	232
Fabric filter	Natural gas	0	CO_2	1	C	NA	14 (28)	233
Fabric filter	Natural gas	ND	CO_2	1	C	NA	16 (31)	234
Fabric filter	Natural gas	15	CO_2	1	C	NA	7.5 (15)	235
Fabric filter	Natural gas	ND	CO_2	1	C	NA	12 (23)	237
Fabric filter	Natural gas	ND	CO_2	1	C	NA	14 (27)	238
Fabric filter	Natural gas	ND	Filterable PM	1	C	NA	0.0047 (0.0093)	239
Fabric filter	Natural gas	ND	Cond. organic PM	1	C	NA	0.00013 (0.00027)	239
Fabric filter	Natural gas	ND	Cond. inorganic PM	1	C	NA	0.00036 (0.00073)	239
Fabric filter	Natural gas	ND	CO_2	3	C	16-22 (33-45)	19 (37)	239
Fabric filter	Propane	ND	Filterable PM	3	A	0.0035-0.0058 (0.0070-0.012)	0.0049 (0.0097)	240
Fabric filter	Propane	ND	Cond. PM	3	A	0.0014-0.0081 (0.0029-0.016)	0.0038 (0.0076)	240
Fabric filter	Propane	ND	CO_2	3	A	14-21 (28-43)	17 (34)	240
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0032-0.0049 (0.0064-0.0098)	0.0040 (0.0080)	248
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	14-18 (27-36)	16 (31)	248
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0011-0.0019 (0.0022-0.0038)	0.0016 (0.0031)	249
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	B	$0\text{-}1.8x10^{-5}$ ($0\text{-}3.5x10^{-5}$)	$5.9x10^{-6}$ ($1.2x10^{-5}$)	249
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	B	0.00041-0.0031 (0.00083-0.0062)	0.0021 (0.0042)	249
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	19-21 (38-42)	20 (40)	249

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.031-0.034 (0.061-0.068)	0.033 (0.065)	250
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	11-36 (21-72)	19 (38)	250
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.00069-0.0019 (0.0014-0.0038)	0.0014 (0.0029)	253
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	13-14 (25-29)	14 (27)	253
Fabric filter	No. 2 fuel oil	0	Arsenic	3	A	$1.6x10^{-8}$-$6.1x10^{-8}$ ($3.2x10^{-8}$-$1.2x10^{-7}$)	$3.3x10^{-8}$ ($6.7x10^{-8}$)	226
Fabric filter	No. 2 fuel oil	0	Beryllium	3	A	$3.4x10^{-8}$-$4.1x10^{-8}$ ($6.9x10^{-8}$-$8.2x10^{-8}$)	$3.8x10^{-8}$ ($7.5x10^{-8}$)	226
Fabric filter	No. 2 fuel oil	0	Cadmium	3	A	$2.3x10^{-8}$-$8.1x10^{-8}$ ($4.6x10^{-8}$-$1.6x10^{-7}$)	$4.8x10^{-8}$ ($9.7x10^{-8}$)	226
Fabric filter	No. 2 fuel oil	0	Copper	3	A	$4.2x10^{-7}$-$7.3x10^{-7}$ ($8.3x10^{-7}$-$1.5x10^{-6}$)	$5.6x10^{-7}$ ($1.1x10^{-6}$)	226
Fabric filter	No. 2 fuel oil	0	Manganese	3	A	$3.7x10^{-7}$-$5.4x10^{-7}$ ($7.4x10^{-7}$-$1.1x10^{-6}$)	$4.6x10^{-7}$ ($9.2x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Mercury	3	A	$1.6x10^{-7}$-$2.0x10^{-7}$ ($3.2x10^{-7}$-$3.9x10^{-7}$)	$1.8x10^{-7}$ ($3.6x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Lead	3	A	$3.3x10^{-7}$-$1.0x10^{-6}$ ($6.5x10^{-7}$-$2.1x10^{-6}$)	$5.7x10^{-7}$ ($1.2x10^{-6}$)	226
Fabric filter	No. 2 fuel oil	0	Nickel	3	A	$2.1x10^{-7}$-$3.8x10^{-7}$ ($4.2x10^{-7}$-$7.6x10^{-7}$)	$2.7x10^{-7}$ ($5.4x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Selenium	3	A	$2.1x10^{-7}$-$8.8x10^{-7}$ ($4.2x10^{-7}$-$1.8x10^{-6}$)	$4.4x10^{-7}$ ($8.8x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Zinc	3	A	$1.3x10^{-6}$-$7.1x10^{-6}$ ($2.6x10^{-6}$-$1.4x10^{-5}$)	$3.4x10^{-6}$ ($6.8x10^{-6}$)	226
Fabric filter	No. 2 fuel oil	0	Cadmium	3	A	$5.9x10^{-8}$-$1.2x10^{-7}$ ($1.2x10^{-7}$-$2.3x10^{-7}$)	$9.5x10^{-8}$ ($1.9x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Hexavalent chromium	3	A	$2.9x10^{-8}$-$6.0x10^{-8}$ ($5.8x10^{-8}$-$1.2x10^{-7}$)	$4.3x10^{-8}$ ($8.6x10^{-8}$)	226
Fabric filter	No. 2 fuel oil	0	Total chromium	3	A	$1.7x10^{-7}$-$4.5x10^{-7}$ ($3.3x10^{-7}$-$8.9x10^{-7}$)	$2.6x10^{-7}$ ($5.2x10^{-7}$)	226
Fabric filter	No. 2 fuel oil	0	Formaldehyde	3	A	$9.0x10^{-5}$-0.00017 (0.00018-0.00033)	0.00012 (0.00024)	226
Fabric filter	No. 2 fuel oil	0	NO_x	8	A	0.028-0.039 (0.055-0.078)	0.031 (0.061)	226
Fabric filter	No. 2 fuel oil	0	SO_2	8	A	0.0052-0.016 (0.010-0.031)	0.011 (0.021)	226
Fabric filter	No. 2 fuel oil	0	O_3	8	D	$4.5x10^{-5}$-0.00012 ($8.9x10^{-5}$-0.00023)	$8.4x10^{-5}$ (0.00017)	226
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15-18 (30-37)	17 (33)	226
Fabric filter	No. 2 fuel oil	0	Naphthalene	3	A	$2.7x10^{-6}$-$7.0x10^{-6}$ ($5.4x10^{-6}$-$1.4x10^{-5}$)	$5.4x10^{-6}$ ($1.1x10^{-5}$)	226
Fabric filter	No. 2 fuel oil	0	Acenaphtylene	3	A	$3.2x10^{-9}$-$2.1x10^{-8}$ ($6.4x10^{-9}$-$4.1x10^{-8}$)	$1.0x10^{-8}$ ($2.0x10^{-8}$)	226

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	Acenaphthene	3	A	4.7x10^{-9}-1.5x10^{-8} (9.4x10^{-9}-3.0x10^{-8})	1.0x10^{-8} (2.1x10^{-8})	226
Fabric filter	No. 2 fuel oil	0	Fluorene	3	A	4.5x10^{-8}-2.3x10^{-7} (8.9x10^{-8}-4.6x10^{-7})	1.4x10^{-7} (2.7x10^{-7})	226
Fabric filter	No. 2 fuel oil	0	Phenanthrene	3	A	2.5x10^{-7}-5.5x10^{-7} (4.9x10^{-7}-1.1x10^{-6})	3.7x10^{-7} (7.3x10^{-7})	226
Fabric filter	No. 2 fuel oil	0	Anthracene	3	A	5.5x10^{-9}-1.3x10^{-8} (1.1x10^{-8}-2.5x10^{-8})	8.3x10^{-9} (1.7x10^{-8})	226
Fabric filter	No. 2 fuel oil	0	Fluoranthene	3	A	2.7x10^{-8}-6.5x10^{-8} (5.3x10^{-8}-1.3x10^{-7})	4.4x10^{-8} (8.7x10^{-8})	226
Fabric filter	No. 2 fuel oil	0	Pyrene	3	A	1.8x10^{-8}-4.2x10^{-8} (3.5x10^{-8}-8.4x10^{-8})	3.0x10^{-8} (5.9x10^{-8})	226
Fabric filter	No. 2 fuel oil	0	Chrysene	3	A	5.0x10^{-10}-8.0x10^{-10} (9.9x10^{-10}-1.6x10^{-9})	6.1x10^{-10} (1.2x10^{-9})	226
Fabric filter	No. 2 fuel oil	0	Benz(a)Anthracene	3	A	2.1x10^{-9}-4.5x10^{-9} (4.1x10^{-9}-8.9x10^{-9})	3.2x10^{-9} (6.3x10^{-9})	226
Fabric filter	No. 2 fuel oil	0	Benzo(b)fluoranthene	3	A	2.9x10^{-10}-6.0x10^{-9} (5.7x10^{-10}-1.2x10^{-8})	2.2x10^{-9} (4.5x10^{-9})	226
Fabric filter	No. 2 fuel oil	0	Benzo(k)fluoranthene	3	A	1.8x10^{-10}-1.3x10^{-9} (3.5x10^{-10}-2.6x10^{-9})	5.6x10^{-10} (1.1x10^{-9})	226
Fabric filter	No. 2 fuel oil	0	Benzo(a)pyrene	3	A	1.3x10^{-10}-1.8x10^{-10} (2.5x10^{-10}-3.5x10^{-10})	1.6x10^{-10} (3.1x10^{-10})	226
Fabric filter	No. 2 fuel oil	0	Benzo(g,h,i)perylene	3	A	2.4x10^{-10}-2.6x10^{-10} (4.7x10^{-10}-5.2x10^{-10})	2.5x10^{-10} (5.0x10^{-10})	226
Fabric filter	No. 2 fuel oil	0	Dibenz(a,h)anthracene	3	A	3.0x10^{-11}-8.0x10^{-11} (6.0x10^{-11}-1.6x10^{-10})	4.8x10^{-11} (9.5x10^{-11})	226
Fabric filter	No. 2 fuel oil	0	Indeno(1,2,3-cd)pyrene	3	A	1.5x10^{-10}-1.5x10^{-10} (2.9x10^{-10}-3.0x10^{-10})	1.5x10^{-10} (3.0x10^{-10})	226
Fabric filter	ND	0	Filterable PM	3	C	0.0013-0.0019 (0.0027-0.0038)	0.0017 (0.0034)	256
Fabric filter	ND	0	CO_2	3	C	4.9-5.1 (9.7-10)	5.0 (10)	256
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0034-0.0067 (0.0069-0.014)	0.0050 (0.010)	261
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	B	0-0.00013 (0-0.00027)	5.4x10^{-5} (0.00011)	261
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	B	0.00066-0.0018 (0.0013-0.0036)	0.0012 (0.0025)	261
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	15-16 (29-31)	15 (30)	261
Fabric filter	Propane	ND	Filterable PM	3	A	0.0052-0.0069 (0.010-0.014)	0.0060 (0.012)	263
Fabric filter	Propane	ND	CO_2	3	A	13-14 (27-28)	14 (27)	263
Fabric filter	Reprocessed No. 4 fuel oil	0	Filterable PM	3	A	0.0036-0.0053 (0.0071-0.011)	0.0045 (0.0091)	265

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	Reprocessed No. 4 fuel oil	0	Back half PM (acetone)	3	A	0.0012-0.0027 (0.0024-0.0054)	0.0018 (0.0035)	265
Fabric filter	Reprocessed No. 4 fuel oil	0	Back half PM (water)	3	A	0.019-0.021 (0.038-0.043)	0.020 (0.040)	265
Fabric filter	Reprocessed No. 4 fuel oil	0	CO_2	3	A	12-17 (25-33)	15 (30)	265
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0055-0.0077 (0.011-0.015)	0.0068 (0.014)	264
Fabric filter	Natural gas	0	Back Half PM (acetone)	3	A	0.00084-0.0016 (0.0017-0.0032)	0.0011 (0.0022)	264
Fabric filter	Natural gas	0	Back Half PM (solubles)	3	A	$4.0x10^{-5}$-$5.4x10^{-5}$ ($8.1x10^{-5}$-0.00011)	$4.7x10^{-5}$ ($9.5x10^{-5}$)	264
Fabric filter	Natural gas	0	CO_2	3	A	8.6-11 (17-22)	10 (20)	264
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0024-0.0046 (0.0047-0.0091)	0.0035 (0.0070)	271
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	20-22 (40-45)	21 (42)	271
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0020-0.0025 (0.0039-0.0050)	0.0023 (0.0046)	274
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	9.6-14 (19-27)	12 (24)	274
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	B	0.0079-0.0093 (0.016-0.019)	0.0086 (0.017)	275
Fabric filter	No. 4 fuel oil	0	CO_2	3	B	19-20 (37-39)	19 (38)	275
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0048-0.0076 (0.0097-0.015)	0.0062 (0.012)	276
Fabric filter	Natural gas	0	CO_2	2	B	8.3-9.1 (17-18)	8.7 (17)	276
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0022-0.0023 (0.0044-0.0047)	0.0023 (0.0045)	276
Fabric filter	Natural gas	ND	CO_2	1	B	NA	16 (32)	277
Fabric filter	Natural gas	ND	Cond. inorganic PM	1	NR	NA	0.011 (0.021)	277
Fabric filter	Natural gas	ND	CO_2	1	B	NA	12 (24)	278
Fabric filter	Natural gas	ND	CO_2	1	B	NA	17 (34)	279
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0045-0.0054 (0.0089-0.011)	0.0051 (0.010)	281
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	32-33 (63-66)	32 (64)	281

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0015-0.0024 (0.0030-0.0048)	0.0018 (0.0037)	281
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0059-0.010 (0.012-0.021)	0.0085 (0.017)	282
Fabric filter	Natural gas	ND	CO_2	3	A	13-15 (25-29)	14 (27)	282
Fabric filter	Natural gas	ND	CO	3	A	0.11-0.14 (0.23-0.28)	0.13 (0.25)	282
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	A	0.032-0.037 (0.065-0.074)	0.034 (0.068)	282
Fabric filter	Natural gas	0	Filterable PM	3	B	0.022-0.025 (0.043-0.050)	0.023 (0.046)	283
Fabric filter	Natural gas	0	CO_2	3	B	17-17 (33-33)	17 (33)	283
Fabric filter	Natural gas	0	Filterable PM	3	A	0.021-0.023 (0.042-0.046)	0.022 (0.044)	284
Fabric filter	Natural gas	0	CO_2	3	A	9.0-23 (18-45)	15 (29)	284
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.00086-0.0021 (0.0017-0.0043)	0.0017 (0.0034)	284
Fabric filter	Natural gas	0	CO_2	1	C	NA	12 (24)	285
Fabric filter	Natural gas	ND	CO_2	1	C	NA	10 (20)	286
Fabric filter	Natural gas	0	CO_2	1	C	NA	7.0 (14)	287
Fabric filter	Natural gas	ND	CO_2	1	C	NA	8.8 (18)	288
Fabric filter	Natural gas	ND	CO_2	1	C	NA	11 (22)	289
Venturi scrubber	ND	ND	Filterable PM	3	C	0.047-0.058 (0.094-0.12)	0.052 (0.10)	290
Venturi scrubber	ND	ND	CO_2	3	C	42-58 (83-120)	49 (98)	290
Venturi scrubber	ND	ND	Cond. inorganic PM	3	C	0.0066-0.016 (0.013-0.032)	0.010 (0.021)	290
Venturi scrubber	ND	ND	Filterable PM	3	C	0.045-0.054 (0.090-0.11)	0.049 (0.098)	291
Venturi scrubber	ND	ND	CO_2	3	C	29-30 (58-60)	30 (59)	291
Venturi scrubber	ND	ND	Cond. inorganic PM	3	C	0.0038-0.0069 (0.0076-0.014)	0.0056 (0.011)	291
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.014-0.016 (0.028-0.031)	0.015 (0.029)	296
Fabric filter	Natural gas	ND	CO_2	3	B	22-32 (44-63)	26 (51)	296
Fabric filter	Natural gas	ND	CO	3	D	0.38-0.42 (0.77-0.84)	0.40 (0.80)	296

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.022-0.025 (0.044-0.051)	0.024 (0.048)	302
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	16-21 (33-43)	19 (37)	302
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.0026-0.0033 (0.0052-0.0067)	0.0030 (0.0060)	304
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	24-27 (49-53)	25 (50)	304
Venturi scrubber	Natural gas	0	CO_2	1	C	NA	41 (82)	306
Venturi scrubber	Natural gas	ND	Filterable PM	1	C	NA	0.059 (0.12)	307
Venturi scrubber	Natural gas	ND	CO_2	1	C	NA	57 (110)	307
Venturi scrubber	Natural gas	ND	Cond. inorganic PM	1	C	NA	0.11 (0.21)	307
Fabric filter	Natural gas	10	Filterable PM	3	A	0.0068-0.013 (0.014-0.026)	0.0091 (0.018)	308
Fabric filter	Natural gas	10	CO_2	3	A	5.8-9.6 (12-19)	8.2 (16)	308
Fabric filter	Natural gas	0	Filterable PM	3	A	0.038-0.054 (0.076-0.11)	0.046 (0.091)	310
Fabric filter	Natural gas	0	CO_2	3	A	21-21 (41-42)	21 (42)	310
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0021-0.0028 (0.0041-0.0056)	0.0024 (0.0049)	310
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0098-0.012 (0.020-0.024)	0.011 (0.021)	312
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	6.3-6.8 (13-14)	6.6 (13)	312
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.00011-0.0033 (0.00022-0.0066)	0.0018 (0.0036)	312
Fabric filter	Natural gas	10	Filterable PM	3	A	0.0051-0.0092 (0.010-0.018)	0.0075 (0.015)	313
Fabric filter	Natural gas	10	CO_2	3	A	6.2-6.7 (12-14)	6.4 (13)	313
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0070-0.017 (0.014-0.035)	0.011 (0.021)	314
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	17-17 (34-34)	17 (34)	314
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0015-0.0021 (0.0030-0.0042)	0.0018 (0.0036)	314
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0039-0.0077 (0.0078-0.015)	0.0054 (0.011)	317
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	13-15 (26-30)	14 (27)	317
Fabric filter	No. 4 fuel oil	0	Lead	3	C	$7.5x10^{-7}$-$3.8x10^{-6}$ ($1.5x10^{-6}$-$7.6x10^{-6}$)	$1.9x10^{-6}$ ($3.7x10^{-6}$)	317

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0019-0.0042 (0.0039-0.0085)	0.0028 (0.0055)	318
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	15-16 (31-32)	16 (31)	318
Fabric filter	No. 4 fuel oil	0	Lead	3	C	$1.7x10^{-6}$-$1.8x10^{-6}$ ($3.5x10^{-6}$-$3.5x10^{-6}$)	$1.7x10^{-6}$ ($3.5x10^{-6}$)	318
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0066-0.010 (0.013-0.020)	0.0080 (0.016)	319
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	16-18 (33-35)	17 (34)	319
Fabric filter	No. 4 fuel oil	0	Lead	3	C	$1.8x10^{-6}$-$2.1x10^{-6}$ ($3.6x10^{-6}$-$4.1x10^{-6}$)	$1.9x10^{-6}$ ($3.8x10^{-6}$)	319
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0043-0.0065 (0.0085-0.013)	0.0053 (0.011)	320
Fabric filter	Waste oil	0	CO_2	3	A	18-19 (37-37)	19 (37)	320
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0057-0.012 (0.011-0.024)	0.0084 (0.017)	321
Fabric filter	Waste oil	0	CO_2	3	A	15-17 (29-33)	15 (31)	321
Fabric filter	Waste oil	0	Lead	3	A	$5.1x10^{-6}$-$8.7x10^{-6}$ ($1.0x10^{-5}$-$1.7x10^{-5}$)	$7.0x10^{-6}$ ($1.4x10^{-5}$)	321
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0055-0.0069 (0.011-0.014)	0.0062 (0.013)	323
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	23-27 (46-53)	25 (50)	323
Fabric filter	ND	10	Filterable PM	3	C	0.011-0.017 (0.023-0.034)	0.014 (0.028)	325
Fabric filter	ND	10	CO_2	3	C	8.4-9.7 (17-20)	9.0 (18)	325
Fabric filter	ND	10	Cond. inorganic PM	3	C	0.0061-0.014 (0.012-0.028)	0.0096 (0.019)	325
Fabric filter	ND	10	Cond. organic PM	3	C	0.00095-0.0012 (0.0019-0.0024)	0.0011 (0.0021)	325
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0068-0.012 (0.014-0.025)	0.0094 (0.019)	326
Fabric filter	Natural gas	ND	CO_2	3	A	19-26 (38-52)	24 (47)	326
Fabric filter	Propane	0	Filterable PM	3	A	0.0010-0.0022 (0.0020-0.0045)	0.0016 (0.0033)	327
Fabric filter	Propane	0	CO_2	3	A	24-31 (47-62)	28 (55)	327
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0019-0.011 (0.0038-0.022)	0.0064 (0.013)	328
Fabric filter	Natural gas	ND	CO_2	3	A	13-15 (25-30)	14 (28)	328
Fabric filter	ND	ND	Filterable PM	3	C	0.00078-0.0014 (0.0016-0.0027)	0.0012 (0.0023)	331

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
Fabric filter	ND	ND	CO_2	3	C	12-19 (24-37)	15 (31)	331
Fabric filter	ND	ND	Cond. inorganic PM	3	C	0.00047-0.00087 (0.00094-0.0017)	0.00063 (0.0013)	331
Fabric filter	Coal/ nat. gas	0	Filterable PM	2	B	0.0026-0.0032 (0.0052-0.0063)	0.0029 (0.0057)	336
Fabric filter	Coal/ nat. gas	0	CO_2	3	B	9.9-11 (20-23)	11 (21)	336
Fabric filter	Natural gas	15	CO_2	3	A	10 - 13 (21 - 26)	12 (23)	370
Fabric filter	Natural gas	15	CO	3	A	0.011 - 0.027 (0.021 - 0.055)	0.019 (0.039)	370
Fabric filter	Natural gas	15	CO_2	3	A	10 - 13 (33 - 34)	17 (33)	378
Fabric filter	Natural gas	15	CO	3	A	0.053 - 0.058 (0.11 - 0.12)	0.056 (0.11)	378
Fabric filter	Natural gas	15	CO_2	3	A	14 - 15 (28 - 29)	15 (29)	381
Fabric filter	Natural gas	15	CO	3	A	0.044 - 0.057 (0.089 - 0.11)	0.052 (0.10)	381
Fabric filter	Natural gas	20	Filterable PM	3	A	0.0041 - 0.0051 (0.0083 - 0.010)	0.0045 (0.0090)	382
Fabric filter	Natural gas	20	CO_2	3	A	15 - 16 (31 - 31)	16 (31)	382
Fabric filter	Natural gas	20	Benzene	3	A	0.00016 - 0.00020 (0.00033 - 0.00039)	0.00018 (0.00036)	382
Fabric filter	Natural gas	20	Formaldehyde	3	A	0.00064 - 0.00080 (0.0013 - 0.0016)	0.00074 (0.0015)	382
Fabric filter	Waste oil	ND	SO_2	3	A	0.0010 - 0.0015 (0.0021 - 0.0031)	0.0013 (0.0027)	385
Fabric filter	Waste oil	ND	CO_2	3	A	17 - 18 (33 - 36)	17 (35)	385
Fabric filter	Waste oil	ND	Filterable PM	3	A	0.067 - 0.010 (0.13 - 0.21)	0.088 (0.18)	385
Fabric filter	Waste oil	ND	Condensable inorg. PM	3	A	0.00064 - 0.0016 (0.0013 - 0.0033)	0.0011 (0.0021)	385
Fabric filter	Waste oil	ND	Condensable org. PM	3	A	0.00024 - 0.0013 (0.00047 - 0.0026)	0.00068 (0.0014)	385
Fabric filter	Waste oil	ND	Total condensable PM	3	A	0.0011 - 0.0022 (0.0023 - 0.0044)	0.0017 (0.0035)	385
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0016-0.0032 (0.0032-0.0065)	0.0024 (0.0047)	195
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	6.4-18 (13-35)	12 (24)	195
None	ND	0	Filterable PM-15	ND	D	ND	23% of filt. PM	23
None	ND	0	Filterable PM-10	ND	D	ND	14% of filt. PM	23

Table 4-12 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)[a]	Ref. No.
None	ND	0	Filterable PM-5	ND	D	ND	3.5% of filt. PM	23
None	ND	0	Filterable PM-2.5	ND	D	ND	0.83% of filt. PM	23
Fabric filter	ND	0	Filterable PM-15	1	C	NA	47% of filt. PM	23[p]
Fabric filter	ND	0	Filterable PM-10	1	C	NA	40% of filt. PM	23[p]
Fabric filter	ND	0	Filterable PM-5	1	C	NA	36% of filt. PM	23[p]
Fabric filter	ND	0	Filterable PM-2.5	1	C	NA	33% of filt. PM	23[p]
Fabric filter	ND	0	Filterable PM-1	1	C	NA	30% of filt. PM	23[p]

ND = No data available, NR = not rated, NA = not applicable

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced.
[b] Emission factors developed from data collected during a plant survey.
[c] Plant 2.
[d] Plant 4.
[e] Plant 5.
[f] Plant O.
[g] Control device may provide only incidental control.
[h] Plant U.
[i] Plant X.
[j] Plant AA.
[k] Plant BB.
[l] Plant DD.
[m] Plant EE.
[n] Plant FF.
[o] Average emission factor computed using an assumed detection limit.
[p] Secondary data from Reference 26 within Reference 23.

Table 4-13. SUMMARY OF TEST DATA FOR HOT MIX ASPHALT PLANTS
HOT OIL SYSTEMS

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Emission factor range, kg/l (lb/gal) fuel consumed (unless noted otherwise)	Average emission factor, kg/l (lb/gal) fuel consumed (unless noted otherwise)	Ref. No.
None	No. 2 fuel oil	Naphthalene	3	D	$1.2x10^{-6}$-$2.8x10^{-6}$ ($1.1x10^{-5}$-$2.3x10^{-5}$)	$2.0x10^{-6}$ ($1.7x10^{-5}$)	35
None	No. 2 fuel oil	Acenaphthylene	3	D	$1.7x10^{-8}$-$3.0x10^{-8}$ ($1.4x10^{-7}$-$2.5x10^{-7}$)	$2.4x10^{-8}$ ($2.0x10^{-7}$)	35
None	No. 2 fuel oil	Acenaphthene	3	D	$6.2x10^{-8}$-$6.7x10^{-8}$ ($5.2x10^{-7}$-$5.6x10^{-7}$)	$6.4x10^{-8}$ ($5.3x10^{-7}$)	35
None	No. 2 fuel oil	Fluorene	3	D	$1.6x10^{-7}$-$4.6x10^{-7}$ ($1.3x10^{-6}$-$3.8x10^{-6}$)	$2.8x10^{-7}$ ($2.3x10^{-6}$)	35
None	No. 2 fuel oil	Phenanthrene	3	D	$4.8x10^{-7}$-$8.2x10^{-7}$ ($4.0x10^{-6}$-$6.8x10^{-6}$)	$5.9x10^{-7}$ ($4.9x10^{-6}$)	35
None	No. 2 fuel oil	Anthracene	3	D	$1.7x10^{-8}$-$2.9x10^{-8}$ ($1.4x10^{-7}$-$2.4x10^{-7}$)	$2.2x10^{-8}$ ($1.8x10^{-7}$)	35
None	No. 2 fuel oil	Fluoranthene	3	D	$3.4x10^{-9}$-$6.2x10^{-9}$ ($2.8x10^{-8}$-$5.2x10^{-8}$)	$5.3x10^{-9}$ ($4.4x10^{-8}$)	35
None	No. 2 fuel oil	Pyrene	3	D	$3.2x10^{-9}$-$4.7x10^{-9}$ ($2.7x10^{-8}$-$3.9x10^{-8}$)	$3.8x10^{-9}$ ($3.2x10^{-8}$)	35
None	No. 2 fuel oil	Benzo(b)fluoranthene	3	D	$7.2x10^{-9}$-$1.8x10^{-8}$ ($6.0x10^{-8}$-$1.5x10^{-7}$)	$1.2x10^{-8}$ ($1.0x10^{-7}$)	35
None	No. 2 fuel oil	TCDF (total)	3	D	$6.7x10^{-14}$-$8.2x10^{-13}$ ($5.6x10^{-13}$-$6.8x10^{-12}$)	$4.0x10^{-13}$ ($3.3x10^{-12}$)	35
None	No. 2 fuel oil	PCDF (total)	3	D	$2.4x10^{-14}$-$1.2x10^{-13}$ ($2.0x10^{-13}$-$1.0x10^{-12}$)	$5.8x10^{-14}$ ($4.8x10^{-13}$)	35
None	No. 2 fuel oil	HxCDF (total)	2	D	$1.6x10^{-14}$-$5.8x10^{-13}$ ($1.3x10^{-13}$-$4.8x10^{-12}$)	$2.4x10^{-13}$ ($2.0x10^{-12}$)	35
None	No. 2 fuel oil	HpCDF (total)	2	D	$3.8x10^{-14}$-$2.6x10^{-12}$ ($3.2x10^{-13}$-$2.2x10^{-11}$)	$1.2x10^{-12}$ ($9.7x10^{-12}$)	35
None	No. 2 fuel oil	1,2,3,4,6,7,8-HpCDF	3	D	$9.4x10^{-14}$-$1.0x10^{-12}$ ($7.6x10^{-13}$-$8.4x10^{-12}$)	$4.2x10^{-13}$ ($3.5x10^{-12}$)	35
None	No. 2 fuel oil	OCDF	3	D	$1.2x10^{-13}$-$3.7x10^{-12}$ ($1.0x10^{-12}$-$3.1x10^{-11}$)	$1.4x10^{-12}$ ($1.2x10^{-11}$)	35
None	No. 2 fuel oil	HxCDD (total)	3	D	$2.3x10^{-13}$-$1.3x10^{-12}$ ($1.9x10^{-12}$-$1.1x10^{-11}$)	$7.4x10^{-13}$ ($6.2x10^{-12}$)	35
None	No. 2 fuel oil	1,2,3,7,8,9-HxCDD	3	D	$3.8x10^{-14}$-$1.2x10^{-13}$ ($3.2x10^{-13}$-$1.0x10^{-12}$)	$9.1x10^{-14}$ ($7.6x10^{-13}$)	35
None	No. 2 fuel oil	1,2,3,4,7,8-HxCDD	3	D	$3.8x10^{-14}$-$1.1x10^{-13}$ ($3.2x10^{-13}$-$9.2x10^{-13}$)	$8.3x10^{-14}$ ($6.9x10^{-13}$)	35
None	No. 2 fuel oil	HpCDD (total)	3	D	$1.7x10^{-13}$-$6.7x10^{-12}$ ($1.4x10^{-12}$-$5.6x10^{-11}$)	$2.4x10^{-12}$ ($2.0x10^{-11}$)	35
None	No. 2 fuel oil	1,2,3,4,6,7,8-HpCDD	3	D	$1.7x10^{-13}$-$4.6x10^{-12}$ ($1.4x10^{-12}$-$3.8x10^{-11}$)	$1.8x10^{-12}$ ($1.5x10^{-11}$)	35
None	No. 2 fuel oil	OCDD	3	D	$1.2x10^{-12}$-$5.3x10^{-11}$ ($1.0x10^{-11}$-$4.4x10^{-10}$)	$1.9x10^{-11}$ ($1.6x10^{-10}$)	35
None	No. 2 fuel oil	Formaldehyde	3	D	0.0019-0.0053 (0.016-0.044)	0.0032 (0.027)	35

Table 4-13. (cont.)

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Emission factor range, kg/l (lb/gal) fuel consumed (unless noted otherwise)	Average emission factor, kg/l (lb/gal) fuel consumed (unless noted otherwise)	Ref. No.
None	No. 2 fuel oil	Formaldehyde	3	B	$7.1x10^{-7}$-$1.4x10^{-6}$ ($6.0x10^{-6}$-$1.2x10^{-5}$)	$9.4x10^{-7}$ ($7.9x10^{-6}$)	395[a]
None	No. 2 fuel oil	Carbon monoxide	3	A	$8.3x10^{-5}$-0.00089 (0.00070-0.0075)	0.00043 (0.0036)	395[a]
None	No. 2 fuel oil	Carbon dioxide	3	B	2.4-2.6 (20-22)	2.5 (21)	395[a]
None	No. 2 fuel oil	Formaldehyde	3	B	$1.9x10^{-8}$-$8.6x10^{-8}$ ($1.6x10^{-7}$-$7.2x10^{-7}$)	$4.2x10^{-8}$ ($3.5x10^{-7}$)	395[b]
None	No. 2 fuel oil	Carbon monoxide	3	A	$2.8x10^{-5}$-$7.0x10^{-5}$ (0.00024-0.00059)	$4.6x10^{-5}$ (0.00039)	395[b]
None	No. 2 fuel oil	Carbon dioxide	3	B	4.3-4.5 (36-38)	4.4 (37)	395[b]
None	Natural gas	Formaldehyde	3	A	kg/m^3 (lb/ft^3) $9.8x10^{-8}$-$3.5x10^{-7}$ ($6.1x10^{-9}$-$2.2x10^{-8}$)	kg/m^3 (lb/ft^3) $2.6x10^{-7}$ ($1.6x10^{-8}$)	395[c]
None	Natural gas	Carbon monoxide	3	B	kg/m^3 (lb/ft^3) $1.9x10^{-6}$-$1.9x10^{-6}$ ($1.2x10^{-7}$-$1.2x10^{-7}$)	kg/m^3 (lb/ft^3) $1.9x10^{-6}$ ($1.2x10^{-7}$)	395[c]
None	Natural gas	Carbon dioxide	3	B	kg/m^3 (lb/ft^3) 2.7-2.7 (0.17-0.17)	kg/m^3 (lb/ft^3) 2.7 (0.17)	395[c]
None	No. 2 fuel oil	Formaldehyde	3	A	$1.7x10^{-7}$- $8.0x10^{-7}$ ($1.4x10^{-6}$-$6.7x10^{-6}$)	$4.0x10^{-7}$ ($3.4x10^{-6}$)	395[d]
None	No. 2 fuel oil	Carbon monoxide	3	A	$6.2x10^{-5}$-0.00013 (0.00052-0.0011)	$9.9x10^{-5}$ (0.00083)	395[d]
None	No. 2 fuel oil	Carbon dioxide	3	B	3.2-3.6 (27-30)	3.3 (28)	395[d]

[a] S.T. Wooten, Franklinton, NC, facility.
[b] S.T. Wooten, Clayton, NC, facility.
[c] REA Construction, Mallard Creek, NC, facility.
[d] REA Construction, North Mecklenburg, NC facility.

Table 4-13a. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR FORMALDEHYDE, CARBON MONOXIDE, AND CARBON DIOXIDE FROM HOT MIX ASPHALT PLANTS – HOT OIL SYSTEMS

Type of control	Fuel fired	Pollutant	No. of tests	Emission factor rating	Average emission factor, kg/l (lb/gal) fuel consumed (unless noted)	Converted emission factor, lb/MMBtu	Average emission factor, lb/MMBtu	Candidate emission factors and units	Ref. No.
~~None~~	~~No. 2 fuel oil~~	~~Formaldehyde~~	4	C	~~0.0032 (0.027)~~	~~NA~~	2.5x10^{-5}	Fuel oil-fired HOS 4.2x10^{-7} kg/l (3.5x10^{-6} lb/gal) Natural gas-fired HOS 4.1x10^{-7} kg/m^3 (2.6x10^{-8} lb/ft^3)	~~35~~
None	No. 2 fuel oil	Formaldehyde			4.2x10^{-8} (3.5x10^{-7})	2.5x10^{-6}			395[b]
None	Natural gas	Formaldehyde			kg/m^3 (lb/ft^3) 2.6x10^{-7} (1.6x10^{-8})	1.6x10^{-5}			395[c]
None	No. 2 fuel oil	Formaldehyde			4.0x10^{-7} (3.4x10^{-6})	2.5x10^{-5}			395[d]
None	No. 2 fuel oil	Formaldehyde			9.4x10^{-7} (7.9x10^{-6})	5.7x10^{-5}			395[a]
None	Natural gas	Carbon monoxide	4	C	kg/m^3 (lb/ft^3) 1.9x10^{-6} (1.2x10^{-7})	0.00012	0.0087	Fuel oil-fired HOS 0.00015 kg/l (0.0012 lb/gal) Natural gas-fired HOS 0.00014 kg/m^3 (8.9x10^{-6} lb/ft^3)	395[c]
None	No. 2 fuel oil	Carbon monoxide			4.6x10^{-5} (0.00039)	0.0028			395[b]
None	No. 2 fuel oil	Carbon monoxide			9.9x10^{-5} (0.00083)	0.0059			395[d]
None	No. 2 fuel oil	Carbon monoxide			0.00043 (0.0036)	0.026			395[a]
None	No. 2 fuel oil	Carbon dioxide	4	C	2.5 (21)	150	200	Fuel oil-fired HOS 3.4 kg/l (28 lb/gal) Natural gas-fired HOS 3.3 kg/m^3 (0.20 lb/ft^3)	395[a]
None	Natural gas	Carbon dioxide			kg/m^3 (lb/ft^3) 2.7 (0.17)	170			395[c]
None	No. 2 fuel oil	Carbon dioxide			3.3 (28)	200			395[d]
None	No. 2 fuel oil	Carbon dioxide			4.4 (37)	260			395[b]

[a] S.T. Wooten, Franklinton, NC, facility.
[b] S.T. Wooten, Clayton, NC, facility.
[c] REA Construction, Mallard Creek, NC, facility.
[d] REA Construction, North Mecklenburg, NC facility.

Table 4-14. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR PM; DRUM MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Venturi scrubber	Propane	11	Cond. inorganic PM	3	A	0.00059 (0.0012)	0.0037 (0.0074), A	262
Fabric filter	Waste oil	20	Cond. inorganic PM	3	A	0.00077 (0.0015)		349
Venturi scrubber	No. 2 fuel oil	0	Cond. inorganic PM	3	C	0.00094 (0.0019)		85
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0010 (0.0021)		48
Fabric filter	Waste oil	0	Cond. inorganic PM	3	A	0.0011 (0.0022)		388
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	C	0.0011 (0.0023)		173
Fabric filter	Propane	ND	Cond. inorganic PM	3	A	0.0012 (0.0023)		206
Fabric filter	Fuel oil	0	Cond. inorganic PM	3	A	0.0014 (0.0027)		292
Fabric filter	No. 6 fuel oil	52	Cond. inorganic PM	3	A	0.0016 (0.0032)		63
Venturi scrubber	Natural gas/ coal	0	Cond. inorganic PM	3	A	0.0017 (0.0033)		87
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0018 (0.0035)		309
Fabric filter	Natural gas	0	Cond. inorganic PM	3	B	0.0018 (0.0036)		330
Venturi scrubber	No. 5 fuel oil	35	Cond. inorganic PM	3	B	0.0019 (0.0039)		142
Fabric filter	No. 4 fuel oil	0	Cond. inorganic PM	2	B	0.0019 (0.0039)		130
Venturi scrubber	Fuel oil	0	Cond. inorganic PM	3	A	0.0021 (0.0043)		119
Fabric filter	Propane	20	Cond. inorganic PM	3	B	0.0029 (0.0058)		254
Fabric filter	No. 6 fuel oil	50	Cond. inorganic PM	3	A	0.0031 (0.0062)		81
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0034 (0.0068)		125
Fabric filter	Propane	20	Cond. inorganic PM	3	B	0.0035 (0.0070)		252
Venturi scrubber	No. 2 fuel oil	10	Cond. inorganic PM	2	B	0.0038 (0.0077)		268
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0041 (0.0083)		316
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0042 (0.0083)		311

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Venturi scrubber	No. 2 fuel oil	ND	Cond. inorganic PM	3	B	0.0047 (0.0093)		251
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0059 (0.012)		94
Fabric filter	Coal/natural gas	0	Cond. inorganic PM	3	A	0.0061 (0.012)		133
Fabric filter	ND	0	Cond. inorganic PM	3	B	0.0080 (0.016)		28
Fabric filter	Coal/natural gas	0	Cond. inorganic PM	3	A	0.0082 (0.016)		132
Fabric filter	No. 6 fuel oil	0	Cond. inorganic PM	3	A	0.0084 (0.017)		101
Venturi scrubber	No. 5 fuel oil	50	Cond. inorganic PM	3	A	0.010 (0.020)		148
Fabric filter	Waste oil	30	Cond. inorganic PM	3	A	0.014 (0.027)		25
None	Natural gas	ND[b]	Cond. organic PM	3	A	0.021 (0.041)	0.029 (0.058), E	36
None	Natural gas	0	Cond. organic PM	3	A	0.025 (0.050)		37
None	Natural gas	ND[b]	Cond. organic PM	3	A	0.042 (0.083)		37
Fabric filter	Butane	30	Cond. organic PM	3	A	0.00018 (0.00035)	0.0059 (0.012), A	65
Fabric filter	Propane	20	Cond. organic PM	3	B	0.00021 (0.00042)		254
Fabric filter	Waste oil	20	Cond. organic PM	3	A	0.00030 (0.00059)		349
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.00036 (0.00071)		48
Fabric filter	Natural gas	28	Cond. organic PM	3	A	0.00031 (0.00061)		51
Fabric filter	Propane	20	Cond. organic PM	3	B	0.00040 (0.00081)		252
Fabric filter	Coal/natural gas	0	Cond. organic PM	3	A	0.00042 (0.00083)		133
Fabric filter	Natural gas	30	Cond. organic PM	3	C	0.00053 (0.0011)		56
Fabric filter	No. 6 fuel oil	32	Cond. organic PM	3	A	0.0010 (0.0020)		55
Fabric filter	No. 2 fuel oil	0	Cond. organic PM	3	C	0.0012 (0.0023)		173
Venturi scrubber	No. 2 fuel oil	0	Cond. organic PM	3	C	0.0013 (0.0026)		85

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Venturi scrubber	No. 2 fuel oil	10	Cond. organic PM	2	B	0.0014 (0.0028)		268
Venturi scrubber	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0014 (0.0029)		70
Fabric filter	Waste oil	0	Cond. organic PM	3	A	0.0015 (0.0029)		388
Fabric filter	Waste oil	30	Cond. organic PM	3	A	0.0016 (0.0032)		25
Fabric filter	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0017 (0.0033)		71
Fabric filter	No. 4 fuel oil	0	Cond. organic PM	2	B	0.0020 (0.0039)		130
Fabric filter	No. 2 fuel oil	0	Cond. organic PM	3	A	0.0021 (0.0043)		94
Fabric filter	Natural gas	0	Cond. organic PM	3	B	0.0021 (0.0042)		330
Fabric filter	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0021 (0.0041)		101
Venturi scrubber	No. 2 fuel oil	ND	Cond. organic PM	3	B	0.0023 (0.0046)		251
Fabric filter	Coal/natural gas	0	Cond. organic PM	3	A	0.0028 (0.0056)		132
Fabric filter	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0029 (0.0059)		78
Fabric filter	No. 2 fuel oil	0	Cond. organic PM	3	A	0.0032 (0.0064)		125
Venturi scrubber	Propane	0	Cond. organic PM	3	A	0.0032 (0.0063)		75
Venturi scrubber	Natural gas/ coal	0	Cond. organic PM	3	A	0.0033 (0.0066)		87
Fabric filter	No. 2 fuel oil	42	Cond. organic PM	3	A	0.0057 (0.011)		82
Fabric filter	No. 6 fuel oil	50	Cond. organic PM	3	A	0.0065 (0.013)		81
Fabric filter	No. 6 fuel oil	44	Cond. organic PM	3	A	0.0069 (0.014)		54
Fabric filter	No. 6 fuel oil	52	Cond. organic PM	3	A	0.0070 (0.014)		63
Venturi scrubber	No. 6 fuel oil	0	Cond. organic PM	3,2,3,3	A	0.0071 (0.014)		57-60
Venturi scrubber	Natural gas	ND[b]	Cond. organic PM	3	A	0.0090 (0.018)		36
Fabric filter	No. 6 fuel oil	40	Cond. organic PM	3	A	0.0093 (0.019)		64

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 6 fuel oil	31	Cond. organic PM	3	A	0.0095 (0.019)		73
Venturi scrubber	Natural gas	0,ND[b]	Cond. organic PM	3,3	A	0.010 (0.021)		37
Venturi scrubber	Propane	11	Cond. organic PM	3	A	0.011 (0.022)		262
Fabric filter	No. 6 fuel oil	18	Cond. organic PM	3	A	0.013 (0.026)		74
Fabric filter	No. 6 fuel oil	48	Cond. organic PM	3	A	0.020 (0.041)		68
Fabric filter	Fuel oil	31	Cond. organic PM	3	A	0.021 (0.042)		53
Venturi scrubber	No. 5 fuel oil	35	Cond. organic PM	3	B	0.029 (0.058)		142
Wet scrubber	No. 6 fuel oil	0,46	Cond. organic PM	2,3	B,A	0.037 (0.074)		67
Fabric filter	Natural gas	30	Cond. PM	3	A	0.0023 (0.0046)	0.0041 (0.0082), NR	44
Fabric filter	Natural gas	13	Cond. PM	3	A	0.00048 (0.00096)		45
Fabric filter	No. 2 fuel oil	35	Cond. PM	3	A	0.010 (0.019)		50
Fabric filter	Butane	30	Filterable PM	3	A	0.0029 (0.0058)	0.0067 (0.014), A	65
Fabric filter	Coal/natural gas	0	Filterable PM	3	A	0.0046 (0.0092)		133
Fabric filter	Coal/ natural gas	0	Filterable PM	3	A	0.0060 (0.012)		190
Fabric filter	Waste oil	25	Filterable PM	3	C	0.00044 (0.00089)		40
Fabric filter	Fuel oil	0	Filterable PM	3	A	0.00058 (0.0012)		292
Fabric filter	ND	0	Filterable PM	3	C	0.00061 (0.0012)		335
Fabric filter	Natural gas	20	Filterable PM	3	A	0.00062 (0.0012)		341
Fabric filter	Natural gas	0	Filterable PM	3	C	0.00067 (0.0013)		40
Fabric filter	Natural gas	23	Filterable PM	3	A	0.00068 (0.0014)		384
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.00083 (0.0017)		242
Fabric filter	Drain oil	25	Filterable PM	3	A	0.00087 (0.0017)		373

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Waste oil	0	Filterable PM	3	C	0.00098 (0.0020)		40
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.00096 (0.0019)		269
Fabric filter	Waste oil	20	Filterable PM	3	A	0.0010 (0.0020)		349
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0011 (0.0022)		257
Fabric filter	Natural gas	15	Filterable PM	3	A	0.0012 (0.0023)		383
Fabric filter	Natural gas	30	Filterable PM	3	A	0.0013 (0.0026)		295
Fabric filter	No. 6 fuel oil	48	Filterable PM	3	A	0.0013 (0.0027)		68
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0013 (0.0026)		118
Fabric filter	No. 2 fuel oil	35	Filterable PM	3	A	0.0015 (0.0029)		50
Fabric filter	Natural gas	0	Filterable PM	3	B	0.0015 (0.0030)		330
Fabric filter	Propane	0	Filterable PM	3	A	0.0016 (0.0033)		223
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0018 (0.0037)		182
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0018 (0.0036)		267
Fabric filter	No. 2 fuel oil	42	Filterable PM	3	A	0.0018 (0.0036)		82
Fabric filter	Waste oil	40	Filterable PM	3	C	0.0019 (0.0038)		40
Fabric filter	Propane	ND	Filterable PM	3	A	0.0019 (0.0037)		206
Fabric filter	No. 2 fuel oil	22	Filterable PM	3	A	0.0019 (0.0038)		124
Fabric filter	Natural gas	23	Filterable PM	3	A	0.0019 (0.0038)		343
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0020 (0.0040)		114
Fabric filter	Natural gas	6	Filterable PM	3	A	0.0021 (0.0041)		198
Fabric filter	Propane	12	Filterable PM	3	A	0.0021 (0.0042)		117
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0021 (0.0042)		89

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0021 (0.0041)		160
Fabric filter	ND	0	Filterable PM	3	B	0.0022 (0.0043)		28
Fabric filter	No. 6 fuel oil	52	Filterable PM	3	A	0.0022 (0.0043)		63
Fabric filter	Natural gas	20	Filterable PM	3	A	0.0012 (0.0023)		342
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0023 (0.0046)		147
Fabric filter	Natural gas	26	Filterable PM	3	A	0.0023 (0.0046)		107
Fabric filter	ND	45	Filterable PM	3	C	0.0024 (0.0048)		40
Fabric filter	No. 5 fuel oil	50	Filterable PM	2	B	0.0025 (0.0049)		31
Fabric filter	No. 6 fuel oil	31	Filterable PM	3	A	0.0025 (0.0050)		73
Fabric filter	No. 4 fuel oil	0	Filterable PM	2	B	0.0025 (0.0050)		130
Fabric filter	Drain oil	25	Filterable PM	3	A	0.0025 (0.0050)		372
Fabric filter	No. 2 fuel oil	40	Filterable PM	3	C	0.0026 (0.0053)		40
Fabric filter	Waste oil	30	Filterable PM	3	A	0.0026 (0.0052)		25
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0026 (0.0053)		48
Fabric filter	Drain oil	10	Filterable PM	3	A	0.0027 (0.0053)		345
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0028 (0.0056)		293
Fabric filter	Natural gas	13	Filterable PM	3	A	0.0028 (0.0056)		45
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0030 (0.0060)		91
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0030 (0.0060)		309
Fabric filter	Propane	10	Filterable PM	3	A	0.0030 (0.0059)		294
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0030 (0.0059)		71
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0031 (0.0063)		154

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.0032 (0.0063)		175
Fabric filter	No. 4 waste oil	0	Filterable PM	3	A	0.0033 (0.0065)		178
Fabric filter	Waste oil	40	Filterable PM	3	C	0.0035 (0.0071)		40
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0036 (0.0071)		329
Fabric filter	No. 6 fuel oil	18	Filterable PM	3	A	0.0036 (0.0072)		74
Fabric filter	Natural gas	30	Filterable PM	1	C	0.0036 (0.0073)		168
Fabric filter	Natural gas	28	Filterable PM	3	A	0.0037 (0.0073)		51
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0037 (0.0075)		348
Fabric filter	Propane	20	Filterable PM	3	B	0.0038 (0.0076)		252
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0038 (0.0077)		92
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	B	0.0038 (0.0076)		171
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0041 (0.0081)		167
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0044 (0.0088)		78
Fabric filter	Drain oil	20	Filterable PM	3	A	0.0046 (0.0091)		375
Fabric filter	No. 6 fuel oil	40	Filterable PM	3	A	0.0046 (0.0092)		64
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0047 (0.0094)		387
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0047 (0.0095)		221
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0048 (0.0097)		180
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0048 (0.0097)		128
Fabric filter	Propane	ND	Filterable PM	3	B	0.0049 (0.0098)		209
Fabric filter	Waste oil	52	Filterable PM	3	C	0.0049 (0.0097)		40
Fabric filter	Drain oil	24	Filterable PM	3	A	0.0050 (0.0099)		371

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 6 fuel oil	32	Filterable PM	3	A	0.0050 (0.010)		55
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0050 (0.010)		149
Fabric filter	Drain oil & natural gas	20	Filterable PM	3	A	0.0050 (0.010)		350
Fabric filter	No. 2 fuel oil	0	Filterable PM	5	A	0.0051 (0.010)		334
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0051 (0.010)		125
Fabric filter	Natural gas	30	Filterable PM	3	A	0.0051 (0.010)		44
Fabric filter	No. 6 fuel oil	44	Filterable PM	3	A	0.0051 (0.010)		54
Fabric filter	Drain oil	0	Filterable PM	3	A	0.0051 (0.010)		376
Fabric filter	Natural gas	15	Filterable PM	3	A	0.0052 (0.010)		103
Fabric filter	Fuel oil	31	Filterable PM	3	A	0.0053 (0.011)		52
Fabric filter	ND	0	Filterable PM	3	C	0.0053 (0.011)		260
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0053 (0.011)		273
Fabric filter	Propane	0	Filterable PM	2	A	0.0053 (0.011)		137
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0054 (0.011)		298
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	A	0.0056 (0.011)		192
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.0056 (0.011)		197
Fabric filter	Low-sulfur No. 2 fuel oil	ND	Filterable PM	3	A	0.0056 (0.011)		354
Fabric filter	No. 6 fuel oil	50	Filterable PM	3	A	0.0057 (0.011)		81
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0059 (0.012)		84
Fabric filter	No. 4 fuel oil	10	Filterable PM	2	B	0.0061 (0.012)		315

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0062 (0.012)		297
Fabric filter	No. 2 fuel oil	18	Filterable PM	3	A	0.0062 (0.012)		340
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0063 (0.013)		95
Fabric filter	Propane	10	Filterable PM	3	B	0.0064 (0.013)		210
Fabric filter	Drain oil	0	Filterable PM	3	A	0.0064 (0.013)		347
Fabric filter	Coal/ natural gas	0	Filterable PM	2	A	0.0065 (0.013)		189
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0069 (0.014)		121
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0069 (0.014)		316
Fabric filter	No. 2 fuel oil	16	Filterable PM	3	A	0.0069 (0.014)		122
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0069 (0.014)		311
Fabric filter	Waste oil	0	Filterable PM	3	C	0.0069 (0.014)		40
Fabric filter	Drain oil	20	Filterable PM	3	A	0.0072 (0.014)		377
Fabric filter	Recycled No. 2 fuel oil	23	Filterable PM	3	A	0.0073 (0.015)		339
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0076 (0.015)		112
Fabric filter	Natural gas	30	Filterable PM	3	C	0.0077 (0.015)		40
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0077 (0.015)		388
Fabric filter	Propane	10	Filterable PM	3	A	0.0078 (0.016)		236
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0078 (0.016)		123
Fabric filter	Waste oil	35	Filterable PM	3	C	0.0078 (0.016)		40
Fabric filter	Waste oil	30	Filterable PM	6	A	0.0079 (0.016)		25
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0082 (0.016)		174

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	B	0.0083 (0.017)		105
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0083 (0.017)		303
Fabric filter	Drain oil	24	Filterable PM	3	A	0.0083 (0.017)		344
Fabric filter	Propane, natural gas	0	Filterable PM	2,3	B,A	0.0084 (0.017)		245, 247
Fabric filter	No. 2 fuel oil	0	Filterable PM	2	C	0.0084 (0.017)		173
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0085 (0.017)		27
Fabric filter	No. 5 fuel oil	0	Filterable PM	3	A	0.0088 (0.018)		31
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0090 (0.018)		101
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0096 (0.019)		104
Fabric filter	No. 6 fuel oil	ND	Filterable PM	3	B	0.010 (0.021)		300
Fabric filter	Natural gas	38	Filterable PM	2	B	0.010 (0.020)		144
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.010 (0.021)		214
Fabric filter	Drain oil	ND	Filterable PM	3	A	0.010 (0.021)		374
Fabric filter	No. 2 fuel oil	6.9	Filterable PM	3	A	0.011 (0.022)		246
Fabric filter	No. 4 fuel oil	14	Filterable PM	3	A	0.011 (0.023)		205
Fabric filter	ND	0	Filterable PM	3	C	0.011 (0.022)		40
Fabric filter	Drain oil	10	Filterable PM	3	A	0.011 (0.021)		351
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.012 (0.024)		94
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.012 (0.024)		229
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.012 (0.024)		218
Fabric filter	No. 2 fuel oil	33	Filterable PM	3	A	0.012 (0.023)		33

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Propane	20	Filterable PM	3	B	0.013 (0.025)		254
Fabric filter	No. 4/6 fuel oil	24	Filterable PM	3	B	0.013 (0.026)		301
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.013 (0.027)		90
Fabric filter	Natural gas	0	Filterable PM	2	B	0.013 (0.027)		280
Fabric filter	Natural gas	0	Filterable PM	3	A	0.014 (0.027)		30
Fabric filter	Coal/natural gas	0	Filterable PM	3	A	0.014 (0.029)		132
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.014 (0.027)		26
Fabric filter	Drain oil	0	Filterable PM	3	A	0.015 (0.030)		380
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.016 (0.033)		186
Fabric filter	Propane	31	Filterable PM	2	A	0.016 (0.032)		137
Fabric filter	ND	20	Filterable PM	3	C	0.026 (0.053)		40
Fabric filter	Natural gas	15 – Run 1, 0--Run 2	Filterable PM	2	C	0.032 (0.064)		38
Fabric filter	Drain oil	10	Filterable PM	3	A	0.0038 (0.0077)		346
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.051 (0.10)		153
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.054 (0.11)		93
Fabric filter	Waste oil	0	Filterable PM	3	A	0.071 (0.14)		386
~~Fabric filter (Plant A)~~	~~No. 2 fuel oil, natural gas~~	~~ND~~	~~Filterable PM~~	~~3~~	~~D~~	~~0.11 (0.21)~~		~~22~~
None	Natural gas	0,ND[b]	Filterable PM	3,3	A	1.3 (2.6)	14 (28), D	37
None	Natural gas	ND[b]	Filterable PM	3	A	2.2 (4.4)		36
None	No. 5 fuel oil	50	Filterable PM	3	A	2.7 (5.4)		31

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
None	Natural gas	0,10	Filterable PM	6,2	B	16 (31)		38
None	No. 5 fuel oil	0	Filterable PM	2	B	25 (50)		31
None	No. 2 fuel oil	18	Filterable PM	3	A	36 (73)		340
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	2	B	0.0018 (0.0036)	0.013 (0.026), A	255
Venturi scrubber	ND	0	Filterable PM	3	B	0.0020 (0.0040)		96
Venturi scrubber	No. 4 fuel oil	0	Filterable PM	3	A	0.0021 (0.0042)		322
Venturi scrubber	Natural gas	0, 25-run 4	Filterable PM	3,4	A	0.0022 (0.0045)		211, 212
Venturi scrubber	No. 2 fuel oil	ND	Filterable PM	3	B	0.0046 (0.0093)		251
Wet Scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0049 (0.0098)		187
Venturi scrubber	Natural gas/ coal	0	Filterable PM	3	A	0.0062 (0.012)		87
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0064 (0.013)		324
Venturi scrubber	Propane	11	Filterable PM	3	A	0.0068 (0.014)		262
Venturi scrubber	No. 5 fuel oil	50	Filterable PM	3	A	0.0070 (0.014)		148
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0071 (0.014)		243
Venturi scrubber	Natural gas	0	Filterable PM	2	B	0.0072 (0.014)		258
Venturi scrubber	Natural gas	0	Filterable PM	3,3	A	0.0076 (0.015)		332, 333
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	B	0.0080 (0.016)		29
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0081 (0.016)		259
Wet scrubber	No. 6 fuel oil	46,0	Filterable PM	3,2	A,B	0.0087 (0.017)		67
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.0090 (0.018)		172
Venturi scrubber	Natural gas	0,ND[b]	Filterable PM	3,3	A	0.0092 (0.019)		37

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.0098 (0.020)		99
Venturi scrubber	Natural gas	31	Filterable PM	3	A	0.010 (0.021)		146
Venturi scrubber	No. 5 fuel oil	35	Filterable PM	3	B	0.012 (0.024)		142
Venturi scrubber	No. 2 fuel oil	29	Filterable PM	3	A	0.012 (0.024)		141
Scrubber	No. 2 fuel oil	0	Filterable PM	3	B	0.012 (0.024)		32
Venturi scrubber	No. 4 waste oil	0	Filterable PM	3,3	B,A	0.013 (0.026)		179, 183
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	C	0.014 (0.027)		85
Venturi scrubber	Natural gas/ coal	0	Filterable PM	2	B	0.014 (0.027)		88
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.015 (0.030)		266
Venturi scrubber	Waste oil	0	Filterable PM	3	C	0.016 (0.032)		40
Venturi scrubber	No. 2 fuel oil	10	Filterable PM	2	B	0.018 (0.036)		268
Venturi scrubber	Fuel oil	0	Filterable PM	3	A	0.018 (0.036)		119
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.020 (0.040)		70
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.022 (0.044)		241
Venturi scrubber	Propane	0	Filterable PM	2	B	0.026 (0.052)		75
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.027 (0.053)		109
Venturi scrubber	Fuel oil/coal	0	Filterable PM	2	B	0.036 (0.072)		108
Venturi scrubber	No. 6 fuel oil	0	Filterable PM	3,2,3,3	A,B,A,A	0.046 (0.092)		57-60
Wet Scrubber	ND	ND	Filterable PM	3	C	0.048 (0.097)		191
Venturi scrubber	Natural gas	ND[b]	Filterable PM	3	A	0.049 (0.097)		36
~~Venturi scrubber~~	~~No. 2 fuel oil~~	~~ND~~	~~Filterable PM~~	~~3~~	~~D~~	~~0.30 (0.60)~~		~~166~~

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
None	ND	30	Filterable PM-15	4	A	27% of filt. PM	27% of filt. PM, 3.8 (7.6), E	23
None	ND	30	Filterable PM-10	4	A	23% of filt. PM	23% of filt. PM, 3.2 (6.4), E	23
None	ND	30	Filterable PM-2.5	4	A	5.5% of filt. PM	5.5% of filt. PM 0.77 (1.5), E	23
Fabric filter	ND	30	Filterable PM-15	4	A	35% of filt. PM	35% of filt. PM, 0.0025 (0.0049), E	23
Fabric filter	Waste oil	30	Filterable PM-10	3	A	0.0026 (0.0052) 32.5% of filt. PM	30% of filt. PM, 0.0021 (0.0042), D	25
~~Fabric filter~~	~~Natural gas~~	~~30~~	~~Filterable PM-10~~	~~3~~	~~C~~	~~0.0011 (0.0023) No filt. PM data~~		~~56~~
Fabric filter	No. 2 fuel oil	ND	Filterable PM-10	2	B	0.0029 (0.0058) 24.2% of filt. PM		229
Fabric filter	ND	30	Filterable PM-10	4	A	32% of filt. PM		23
Fabric filter	No. 2 fuel oil	ND	PM-1	2	B	0.00023 (0.00045) 1.9% of filt. PM	15% of filt. PM, 0.0011 (0.0021), E	229
Fabric filter	No. 2 fuel oil	ND	PM-1	3	A	0.0030 (0.0060) 28.6% of filt. PM		214
Fabric filter	ND	30	PM-2.5	4	A	11% of filt. PM	21% of filt. PM, 0.0015 (0.0029), E	23
Fabric filter	No. 2 fuel oil	ND	PM-2.5	2	B	0.00069 (0.0014) 5.8% of filt. PM		229
Fabric filter	No. 2 fuel oil	ND	PM-2.5	3	A	0.0049 (0.0097) 46.2% of filt. PM		214

Table 4-14 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
~~Cyclone or multiclone~~	~~ND~~	~~ND~~	~~Total PM~~	~~ND~~	~~D~~	~~0.34 (0.67)~~		~~11~~
~~None~~	~~ND~~	~~ND~~	~~Total PM~~	~~ND~~	~~D~~	~~2.5 (4.9)~~		~~11~~
~~Venturi scrubber~~	~~ND~~	~~ND~~	~~Total PM~~	~~ND~~	~~D~~	~~0.023 (0.045)~~		~~11~~
~~Wet scrubber~~	~~ND~~	~~ND~~	~~Total PM~~	~~ND~~	~~D~~	~~0.035 (0.070)~~		~~11~~

ND = no data available, NR = not rated, NA = not applicable

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b] Report indicated that RAP was processed during testing, but the percentage of RAP was not specified.

Table 4-15. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR CO, CO_2, METHANE, NO_x, SO_2, AND TOC; DRUM MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Natural gas	ND	CO	3	B	0.0055 (0.011)	0.063 (0.13), B	197
Fabric filter	Natural gas	0	CO	2	B	0.0070 (0.014)		357
Fabric filter	No. 2 fuel oil	ND	CO	3	A	0.014 (0.028)		214
Fabric filter	Drain oil	10	CO	3	A	0.015 (0.030)		346
Fabric filter	Waste oil	30	CO	10	A	0.019 (0.038)		25
Fabric filter	No. 2 fuel oil	ND	CO	3	A	0.024 (0.047)		229
Fabric filter	Natural gas	0	CO	5	A	0.028 (0.056)		48
Fabric filter	Drain oil	24	CO	3	A	0.029 (0.059)		344
Fabric filter	No. 2 fuel oil	18	CO	3	A	0.041 (0.083)		340
Fabric filter	Natural gas	20	CO	3	A	0.043 (0.086)		342
Fabric filter	Drain oil	0	CO	3	A	0.053 (0.11)		347
Fabric filter	Propane	20	CO	3	B	0.082 (0.17)		254
Fabric filter	No. 2 fuel oil	0	CO	3	A	0.086 (0.17)		149
Fabric filter	No. 2 fuel oil	0	CO	1	C	0.091 (0.18)		154
Fabric filter	Natural gas	30	CO	1	C	0.094 (0.19)		44
Fabric filter	Recycled No. 2 fuel oil	23	CO	4	A	0.10 (0.20)		339
Fabric filter	Natural gas	20	CO	3	A	0.10 (0.21)		341
Fabric filter	No. 2 fuel oil	35	CO	9	C	0.30 (0.60)		50
~~Fabric filter~~	~~Propane~~	~~ND~~	~~CO~~	~~3~~	~~B~~	~~3.0 (6.0)~~		~~209~~
Fabric filter	Butane	30	CO_2	3	A	21 (42)	17 (33), A	65
Fabric filter	Coal/natural gas	0	CO_2	3	B	8.5 (17)		133
Fabric filter	Coal/natural gas	0	CO_2	3	B	13 (26)		189
Fabric filter	Coal/natural gas	0	CO_2	3	A	15 (30)		190
Fabric filter	Drain oil	24	CO_2	3	A	15 (31)		371
Fabric filter	Drain oil	25	CO_2	3	A	16 (32)		373
Fabric filter	Coal/natural gas	0	CO_2	3	B	19 (37)		132
Fabric filter	Drain oil	25	CO_2	3	A	19 (38)		372
Fabric filter	Fuel oil	0	CO_2	3	A	9.8 (20)		292
Venturi scrubber	Fuel oil/coal	0	CO_2	2	B	16 (32)		108
Fabric filter	Fuel oil	31	CO_2	3	A	19 (39)		53

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Venturi scrubber	Fuel oil	0	CO_2	3	C	19 (39)		119
Fabric filter	Propane	12	CO_2	3	B	6.1 (12)		117
Fabric filter	Propane	0,31	CO_2	2,2	B,B	10 (20)		137
Fabric filter	Propane	ND	CO_2	3	A	9.7 (19)		206
Fabric filter	Natural gas	23	CO_2	3	A	12 (23)		384
Fabric filter	Propane	0	CO_2	3	A	12 (24)		223
Fabric filter	Propane	ND	CO_2	3	B	13 (27)		209
Fabric filter	Propane	10	CO_2	3	A	13 (27)		294
Venturi scrubber	Propane	0	CO_2	3	A	13 (27)		75
Fabric filter	Propane	10	CO_2	3	B	15 (30)		210
Fabric filter	Propane, natural gas	0	CO_2	4,3	B,A	13 (27)		245,247
Venturi scrubber	Propane	11	CO_2	3	A	17 (33)		262
Fabric filter	Propane	20	CO_2	3	B	17 (34)		254
Fabric filter	Propane	20	CO_2	3	B	18 (36)		252
Fabric filter	Propane	10	CO_2	3	A	19 (38)		236
Venturi scrubber	Natural gas	0	CO_2	3	A	4.5 (9.0)		259
Fabric filter	Natural gas	15	CO_2	3	B	4.5 (8.9)		103
Fabric filter	Natural gas	26	CO_2	3	B	5.1 (10)		107
Fabric filter	Natural gas	0	CO_2	3	A	6.8 (14)		329
Fabric filter	Natural gas	0	CO_2	3	A	8.5 (17)		221
Fabric filter	Natural gas	0	CO_2	3	B	9.0 (18)		167
Venturi scrubber	Natural gas	0	CO_2	3	A	9.4 (19)		172
Fabric filter	Natural gas	0	CO_2	3	A	9.6 (19)		30
Fabric filter	Natural gas	0	CO_2	3	A	9.8 (20)		180
Fabric filter	Natural gas	0	CO_2	3	B	10 (21)		118
Fabric filter	Natural gas	0	CO_2	3	A	11 (22)		257
Venturi scrubber	Natural gas	0	CO_2	3,3	A	11 (22)		332,333
Fabric filter	Natural gas	6	CO_2	3	A	11 (23)		198
Fabric filter	Natural gas	30	CO_2	3	A	12 (23)		295
Fabric filter	Natural gas	38	CO_2	2	B	12 (23)		144
Venturi scrubber	Natural gas	31	CO_2	3	A	12 (25)		146
Fabric filter (cont. mix plant)	Natural gas	0	CO_2	3	A	12 (25)		244
Fabric filter	Natural gas	ND	CO_2	3	B	12 (23)		197

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Natural gas	30	CO_2	3	A	13 (26)		56
Fabric filter	Natural gas	30	CO_2	3	A	13 (25)		44
Fabric filter	Natural gas	0	CO_2	3	B	13 (26)		92
Fabric filter	Natural gas	0	CO_2	8	A	14 (28)		163
Venturi scrubber	Natural gas	0	CO_2	3,4	B	14 (28)		211,212
Fabric filter	Natural gas	0	CO_2	3	B	15 (29)		330
Fabric filter	Natural gas	27	CO_2	3	C	15 (31)		168
Fabric filter	Natural gas	0	CO_2	3	A	15 (29)		309
Fabric filter	Natural gas	13	CO_2	3	A	16 (31)		45
Fabric filter	Natural gas	0	CO_2	6	A	17 (34)		48
Fabric filter	Natural gas	28	CO_2	3	A	18 (36)		51
Venturi scrubber	Natural gas/ coal	0	CO_2	3	B	19 (38)		88
Fabric filter	Natural gas	0	CO_2	3	B	21 (43)		84
Fabric filter	Natural gas	0	CO_2	2	B	25 (49)		280
Venturi scrubber	Natural gas/ coal	0	CO_2	3	B	27 (54)		87
Venturi scrubber	Natural gas	0	CO_2	3	B	33 (66)		258
Venturi scrubber	ND	0	CO_2	3	B	10 (20)		96
Fabric filter	ND	ND	CO_2	3	C	16 (31)		335
Wet Scrubber	ND	ND	CO_2	3	C	16 (32)		191
Fabric filter	ND	0	CO_2	3	B	17 (34)		28
Fabric filter	ND	0	CO_2	3	C	21 (42)		260
Fabric filter	No. 2 fuel oil	ND	CO_2	5	B	1.3 (2.6)		153
Wet Scrubber	No. 2 fuel oil	0	CO_2	3	A	7.3 (15)		187
Fabric filter	No. 2 fuel oil	22	CO_2	3	B	9.3 (19)		124
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	11 (21)		196
Fabric filter	No. 2 fuel oil	33	CO_2	3	A	11 (22)		33
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	11 (22)		218
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	11 (23)		125
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	11 (22)		182
Fabric filter	No. 2 fuel oil	ND	CO_2	2	C	12 (24)		229
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	12 (25)		267
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	13 (25)		109
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	13 (25)		123

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	13 (26)		112
Fabric filter	Drain oil	0	CO_2	3	A	13 (26)		376
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14 (29)		171
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	14 (28)		91
Fabric filter	No. 2 fuel oil	6.9	CO_2	3	A	14 (29)		246
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	14 (29)		214
Fabric filter	Drain oil and natural gas	20	CO_2	3	A	14 (27)		350
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	14 (27)		293
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14 (28)		154
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14 (27)		114
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	14 (28)		324
Fabric filter	Natural gas	20	CO_2	3	A	15 (31)		342
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15 (31)		95
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15 (30)		27
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	15 (31)		269
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	15 (30)		121
Fabric filter	No. 5 fuel oil	ND	CO_2	3	A	15 (30)		353
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	15 (30)		149
Fabric filter	No. 2 fuel oil	ND	CO_2	2	B	15 (31)		175
Venturi scrubber	No. 2 fuel oil	0	CO_2	3,3	A	15 (31)		241,242
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	16 (31)		94
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	16 (31)		29
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	16 (31)		303
Fabric filter	Waste oil	0	CO_2	3	A	16 (31)		348
Venturi scrubber	No. 2 fuel oil	ND	CO_2	3	A	16 (32)		166
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	16 (32)		89
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	16 (33)		273
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	17 (35)		93
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	17 (34)		311
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	17 (34)		316
Fabric filter	Natural gas	23	CO_2	3	A	18 (35)		343
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	18 (35)		243
Venturi scrubber	No. 2 fuel oil	ND	CO_2	3	B	18 (35)		251
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	18 (36)		104

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Venturi scrubber	No. 2 fuel oil	29	CO_2	3	B	18 (36)		141
Fabric filter	Natural gas	15	CO_2	3	A	18 (36)		383
Fabric filter	No. 2 fuel oil	0	CO_2	5	A	18 (37)		334
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	19 (37)		26
Fabric filter	Natural gas	20	CO_2	3	A	19 (38)		341
Scrubber	No. 2 fuel oil	0	CO_2	3	B	19 (38)		32
Fabric filter	Drain oil	20	CO_2	3	A	19 (38)		375
Fabric filter	No. 2 fuel oil	0	CO_2	9	A	19 (37)		164
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	19 (38)		105
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	C	19 (38)		85
Fabric filter	Drain oil	0	CO_2	3	A	19 (38)		380
Fabric filter	Waste oil	0	CO_2	3	A	20 (39)		386
Fabric filter	Waste oil	20	CO_2	3	A	20 (41)		349
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	20 (41)		90
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	20 (40)		174
Fabric filter	Waste oil	0	CO_2	3	A	20 (40)		388
Fabric filter	Waste oil	0	CO_2	3	A	20 (40)		388
Fabric filter	Waste oil	0	CO_2	3	A	21 (41)		388
Fabric filter	Drain oil	10	CO_2	3	A	21 (41)		351
Fabric filter	Drain oil	15	CO_2	3	A	21 (42)		379
Fabric filter	Drain oil	20	CO_2	3	A	22 (43)		377
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	22 (44)		186
Fabric filter	No. 2 and No. 5 fuel oil	ND	CO_2	2	A	22 (44)		352
Fabric filter	Low-sulfur No. 2 fuel oil	ND	CO_2	3	A	22 (45)		354
Fabric filter	No. 2 fuel oil	ND	CO_2	3	C	23 (46)		173
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	23 (45)		192
Fabric filter	Waste oil	0	CO_2	3	A	23 (45)		387
Fabric filter	Waste oil	0	CO_2	3	A	23 (47)		387
Fabric filter	Drain oil	24	CO_2	3	A	24 (48)		344
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	24 (48)		99
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	B	24 (48)		255
Venturi scrubber	No. 2 fuel oil	0	CO_2	8	B	25 (50)		162
Venturi scrubber	No. 2 fuel oil	10	CO_2	2	B	26 (52)		268

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Drain oil	ND	CO_2	3	A	29 (59)		374
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	30 (59)		160
Fabric filter	No. 2 fuel oil	35	CO_2	9	A	32 (65)		50
Venturi scrubber	No. 2 fuel oil	0	CO_2	3	A	34 (68)		266
Fabric filter	No. 2 fuel oil	42	CO_2	3	A	36 (71)		82
Venturi scrubber	No. 4 fuel oil	0	CO_2	3	A	3.9 (7.8)		322
Fabric filter	No. 4 fuel oil	14	CO_2	3	A	8.3 (17)		205
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	11 (22)		298
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	11 (22)		297
Fabric filter	No. 4/6 fuel oil	24	CO_2	3	B	12 (23)		301
Fabric filter	No. 4 fuel oil	0	CO_2	2	B	16 (31)		130
Fabric filter	No. 4 waste oil	0	CO_2	3	A	19 (39)		178
Fabric filter	No. 4 fuel oil	10	CO_2	3	B	19 (37)		315
Fabric filter	No. 4 fuel oil	0	CO_2	3	B	20 (41)		128
Venturi scrubber	No. 5 fuel oil	35	CO_2	3	B	24 (48)		142
Fabric filter	No. 6 fuel oil	52	CO_2	3	A	7.5 (15)		63
Fabric filter	No. 6 fuel oil	18	CO_2	3	A	11 (22)		74
Fabric filter	No. 6 fuel oil	44	CO_2	3	A	13 (27)		54
Fabric filter	No. 6 fuel oil	50	CO_2	3	A	14 (28)		81
Fabric filter	No. 6 fuel oil	48	CO_2	3	A	14 (28)		68
Fabric filter	No. 6 fuel oil	40	CO_2	3	A	16 (33)		64
Fabric filter	No. 6 fuel oil	ND	CO_2	3	B	16 (32)		300
Fabric filter	Drain oil	10	CO_2	3	A	17 (33)		346
Venturi scrubber	No. 6 fuel oil	0	CO_2	3	A	17 (34)		70
Venturi scrubber	No. 6 fuel oil	0	CO_2	11	A,B, A,A	27 (54)		57-60
Fabric filter	No. 6 fuel oil	31	CO_2	3	A	17 (34)		73
Fabric filter	No. 6 fuel oil	32	CO_2	3	A	18 (35)		55
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	18 (35)		147
Fabric filter	Drain oil	10	CO_2	3	A	20 (40)		345
Fabric filter	No. 6 fuel oil	0	CO_2	3	A	20 (40)		78
Fabric filter	No. 6 fuel oil	0	CO_2	3	A	23 (45)		71
Wet scrubber	No. 6 fuel oil	0,46	CO_2	2,3	B,A	31 (61)		67
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	31 (63)		101

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Drain oil	0	CO_2	3	A	48 (96)		347
Fabric filter[b]	Waste oil	30	CO_2	9	A	19 (38)		25
Venturi scrubber	Waste oil	0	CO_2	3,3	B,A	16 (32)		179,183
Fabric filter	Natural gas	0	Methane	3	C	6.8×10^{-5} (0.00014)	0.0058 (0.012), C	48
Fabric filter	Natural gas	0	Methane	2	B	0.00040 (0.00080)		355
Fabric filter	Natural gas	13	Methane	3	A	0.0016 (0.0032)		45
Fabric filter	No. 2 fuel oil	18	Methane	3	A	0.0018 (0.0036)		340
Fabric filter	Recycled No. 2 fuel oil	23	Methane	4	A	0.0041 (0.0082)		339
Fabric filter	No. 2 fuel oil	35	Methane	9	A	0.0071 (0.014)		50
Fabric filter	Waste oil	30	Methane	19	B	0.012 (0.025)		25
Fabric filter	Natural gas	30	Methane	3	A	0.019 (0.038)		44
Fabric filter	Natural gas	30	NO_x	3	A	0.0075 (0.015)	0.013 (0.026), D	44
Fabric filter	Natural gas	20	NO_x	3	A	0.0087 (0.017)		341
Fabric filter	Natural gas	13	NO_x	3	A	0.0091 (0.018)		45
Fabric filter	Natural gas	20	NO_x	3	A	0.012 (0.023)		342
Fabric filter	Propane	ND	NO_x	3	B	0.016 (0.032)		209
Fabric filter	Natural gas	0	NO_x	6	A	0.025 (0.049)		48
Fabric filter	Drain oil	24	NO_x	3	A	0.0083 (0.017)	0.028 (0.055), C	344
Fabric filter	Drain oil	10	NO_x	3	A	0.0084 (0.017)		346
Fabric filter	No. 2 fuel oil	ND	NO_x	3	A	0.012 (0.025)		229
Fabric filter	No. 2 fuel oil	ND	NO_x	3	B	0.016 (0.032)		153
Fabric filter	No. 2 fuel oil	ND	NO_x	3	A	0.025 (0.050)		214
Fabric filter	No. 5 fuel oil	ND	NO_x	3	A	0.031 (0.062)		353
Fabric filter	Waste oil	30	NO_x	10	A	0.034 (0.068)		25
Fabric filter	No. 2 and No. 5 fuel oil	ND	NO_x	2	A	0.034 (0.068)		352
Fabric filter	Low-sulfur No. 2 fuel oil	ND	NO_x	3	A	0.038 (0.076)		354
Fabric filter	No. 2 fuel oil	35	NO_x	9	A	0.041 (0.081)		50
Fabric filter	Drain oil	0	NO_x	9	A	0.057 (0.11)		347
Venturi scrubber	Natural gas/coal	0	SO_2	3	A	0.0012 (0.0024)	0.097 (0.19), E	88
Venturi scrubber	Fuel oil/coal	0	SO_2	2	B	0.0047 (0.0094)		108

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Coal	0	SO_2	3	A	0.0062 (0.012)		190
Fabric filter	Coal/natural gas	0	SO_2	3	A	0.38 (0.75)		189
Fabric filter	Natural gas	13	SO_2	3	A	0.00062 (0.0012)	0.0017 (0.0034), D	45
Fabric filter	Natural gas	30	SO_2	3	A	0.0021 (0.0041)		44
Fabric filter	Natural gas	0	SO_2	5	A	0.0024 (0.0048)		48
Venturi scrubber	No. 2 fuel oil	0	SO_2	3	A	0.00048 (0.00095)	0.0054 (0.011), E	255
Venturi scrubber	Fuel oil	0	SO_2	3	C	0.0023 (0.0047)		119
Fabric filter	No. 2 fuel oil	35	SO_2	5	A	0.0054 (0.011)		50
Fabric filter	No. 2 fuel oil	18	SO_2	3	A	0.013 (0.026)		340
~~Fabric filter~~	~~Drain oil and natural gas~~	~~20~~	~~SO_2~~	~~3~~	~~A~~	~~0.0038 (0.0076)~~	0.029 (0.058), B	~~350~~
Fabric filter	Drain oil	25	SO_2	3	A	0.0040 (0.0081)		372
Fabric filter	No. 6 fuel oil	ND	SO_2	3	B	0.0077 (0.015)		300
Fabric filter	Drain oil	0	SO_2	3	A	0.0097 (0.019)		376
Fabric filter	Drain oil	ND	SO_2	3	A	0.014 (0.028)		374
Fabric filter	Drain oil	15	SO_2	3	A	0.024 (0.047)		379
Fabric filter	Waste oil	0	SO_2	3	A	0.024 (0.049)		388
Fabric filter	Drain oil	20	SO_2	3	A	0.026 (0.053)		377
Fabric filter	Drain oil	20	SO_2	3	A	0.026 (0.053)		375
Fabric filter	Recycled No. 2 fuel oil	23	SO_2	4	A	0.027 (0.054)		339
Fabric filter	Drain oil	25	SO_2	3	B	0.028 (0.056)		373
Fabric filter	Drain oil	24	SO_2	3	A	0.030 (0.059)		371
Fabric filter	Waste oil	0	SO_2	3	A	0.030 (0.061)		387
Fabric filter	Drain oil	10	SO_2	3	A	0.033 (0.066)		345
Fabric filter	Drain oil	0	SO_2	3	A	0.034 (0.068)		380
Fabric filter	Waste oil	0	SO_2	3	A	0.036 (0.071)		386
Fabric filter	Drain oil	10	SO_2	3	A	0.036 (0.073)		351
Fabric filter	Waste oil	30	SO_2	10	A	0.049 (0.098)		25
Fabric filter (used neutralizing agent to reduce SO_2)	No. 6 fuel oil	19	SO_2	3	A	0.081 (0.16)		299

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.0029 (0.0058)	0.021 (0.041), B	149
Fabric filter	Natural gas	0	TOC as propane	6	A	0.0037 (0.0073)		48
Fabric filter	Natural gas	0	TOC as propane	2	B	0.0037 (0.0073)		355
Fabric filter	No. 2 fuel oil	ND	TOC as propane	3	B	0.0062 (0.012)		153
Fabric filter	No. 2 fuel oil	ND	TOC as propane	3	A	0.0073 (0.015)		214
Fabric filter	No. 2 fuel oil	0	TOC as propane	1	C	0.012 (0.023)		154
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.015 (0.030)		242
Fabric filter	Recycled No. 2 fuel oil	23	TOC as propane	8	A	0.018 (0.036)		339
Fabric filter	No. 2 fuel oil	35	TOC as propane	9	A	0.018 (0.036)		50
Venturi scrubber	No. 2 fuel oil	0	TOC as propane	3	A	0.018 (0.037)		241
Fabric filter	Natural gas	13	TOC as propane	3	A	0.020 (0.039)		45
Fabric filter	Propane	ND	TOC as propane	3	B	0.022 (0.044)		209
Fabric filter	No. 2 fuel oil	18	TOC as propane	6	A	0.026 (0.053)		340
Venturi scrubber	Natural gas	0[b]	TOC as propane	3,4	A	0.031 (0.062)		211,212
Fabric filter	Natural gas	30	TOC as propane	3	A	0.040 (0.080)		44
Fabric filter	Waste oil	30	TOC as propane	10	A	0.046 (0.091)		25
Fabric filter	Propane	10	TOC as propane	3	B	0.059 (0.12)		210
~~Fabric filter~~	~~Propane~~	~~10~~	~~VOC (TNMOC)~~	~~2~~	~~D~~	~~0.032 (0.064)~~		~~236~~
~~Fabric filter (Plant B)~~	~~Propane~~	~~ND~~	~~VOC (TNMOC)~~	~~5~~	~~D~~	~~0.033 (0.066)~~		~~22~~
~~Venturi scrubber (Plant E)~~	~~Natural gas~~	~~ND~~	~~VOC (TNMOC)~~	~~5~~	~~D~~	~~0.080 (0.16)~~		~~22~~

Table 4-15 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
~~Fabric filter (Plant A)~~	~~Natural gas~~	~~ND~~	~~VOC (TNMOC)~~	~~1~~	~~NR~~	~~0.11 (0.22)~~		~~22~~
~~None (Plant E)~~	~~Natural gas~~	~~ND~~	~~VOC (TNMOC)~~	~~3~~	~~D~~	~~0.16 (0.31)~~		~~22~~
~~Fabric filter (Plant D)~~	~~Natural gas~~	~~0 to 30~~	~~VOC (TNMOC)~~	~~5~~	~~D~~	~~0.16 (0.33)~~		~~22~~
~~Fabric filter (Plant A)~~	~~No. 2 fuel oil~~	~~ND~~	~~VOC (TNMOC)~~	~~2~~	~~D~~	~~0.11 (0.21)~~		~~22~~
~~Fabric filter (Plant C)~~	~~No. 4 fuel oil~~	~~ND~~	~~VOC (TNMOC)~~	~~4~~	~~D~~	~~0.050 (0.10)~~		~~22~~

ND = no data available, NR = not rated

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b] Run 4 of the Reference 212 test included 25 percent RAP.

Table 4-16. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR METALS; DRUM MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Recycled No. 2 fuel oil	23[b]	Antimony	4	A	$4.2x10^{-9}$ ($8.3x10^{-9}$)	$9.0x10^{-8}$ ($1.8x10^{-7}$), E	339
Fabric filter	No. 2 fuel oil	18[c]	Antimony	3	A	$1.8x10^{-7}$ ($3.5x10^{-7}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Arsenic	4	A	$5.2x10^{-8}$ ($1.0x10^{-7}$)	$2.8x10^{-7}$ ($5.6x10^{-7}$), D	339
Fabric filter	Propane	ND	Arsenic	3	B	$1.3x10^{-7}$ ($2.5x10^{-7}$)		35
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Arsenic~~	~~3~~	~~D~~	~~$8.7x10^{-8}$ ($1.7x10^{-7}$)~~		~~142~~
Fabric filter	Waste oil	30	Arsenic	3	A	$9.5x10^{-7}$ ($1.9x10^{-6}$)		25
Fabric filter	No. 2 fuel oil	18[c]	Arsenic	3	B	0 (0)		340
Fabric filter	Waste oil	30	Barium	3	A	$2.4x10^{-6}$ ($4.8x10^{-6}$)	$2.9x10^{-6}$ ($5.8x10^{-6}$), D	25
Fabric filter	Recycled No. 2 fuel oil	23[b]	Barium	4	A	$3.8x10^{-6}$ ($7.5x10^{-6}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Barium	3	A	$2.6x10^{-6}$ ($5.2x10^{-6}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Beryllium	4	B	0 (0)	0(0), E	339
Fabric filter	No. 2 fuel oil	18[c]	Beryllium	3	B	0 (0)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Cadmium	4	A	$4.9x10^{-8}$ ($9.8x10^{-8}$)	$2.0x10^{-7}$ ($4.1x10^{-7}$), D	339
Fabric filter	Propane	ND	Cadmium	3	B	$1.3x10^{-7}$ ($2.5x10^{-7}$)		35
Venturi scrubber	No. 2 fuel oil	0	Cadmium	2	C	$6.4x10^{-7}$ ($1.3x10^{-6}$)		162
Fabric filter	No. 4/6 fuel oil	24	Cadmium	3	B	$7.4x10^{-8}$ ($1.5x10^{-7}$)		301
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Cadmium~~	~~3~~	~~D~~	~~$3.6x10^{-7}$ ($7.2x10^{-7}$)~~		~~142~~
Fabric filter	Waste oil	30	Cadmium	3	A	$3.1x10^{-7}$ ($6.2x10^{-7}$)		25
Fabric filter	No. 2 fuel oil	18[c]	Cadmium	3	A	$1.5x10^{-8}$ ($3.1x10^{-8}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Chromium	4	A	$1.0x10^{-7}$ ($2.1x10^{-7}$)	$2.8x10^{-6}$ ($5.5x10^{-6}$), C	339
Fabric filter	Natural gas	0	Chromium	2	B	$2.3x10^{-6}$ ($4.5x10^{-6}$)		163
Venturi scrubber	No. 2 fuel oil	0	Chromium	2	B	$1.6x10^{-6}$ ($3.2x10^{-6}$)		162
Fabric filter	No. 2 fuel oil	0	Chromium	3	A	$8.0x10^{-6}$ ($1.6x10^{-5}$)		164
Fabric filter	No. 4/6 fuel oil	24	Chromium	3	B	$7.4x10^{-7}$ ($1.5x10^{-6}$)		301
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Chromium~~	~~3~~	~~D~~	~~$2.5x10^{-6}$ ($5.1x10^{-6}$)~~		~~142~~
Fabric filter	Waste oil	30	Chromium	3	A	$6.0x10^{-6}$ ($1.2x10^{-5}$)		25
Fabric filter	No. 2 fuel oil	18[c]	Chromium	3	A	$5.7x10^{-7}$ ($1.1x10^{-6}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Cobalt	4	B	$2.6x10^{-8}$ ($5.1x10^{-8}$)	$1.3x10^{-8}$ ($2.6x10^{-8}$), E	339
Fabric filter	No. 2 fuel oil	18[c]	Cobalt	3	B	0 (0)		340
Fabric filter	Natural gas	0	Copper	3	A	$1.7x10^{-6}$ ($3.4x10^{-6}$)	$1.6x10^{-6}$ ($3.1x10^{-6}$), D	163

Table 4-16 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Venturi scrubber	No. 2 fuel oil	0	Copper	2	C	$2.2x10^{-7}$ ($4.4x10^{-7}$)		162
Fabric filter	No. 2 fuel oil	0	Copper	3	A	$3.6x10^{-6}$ ($7.1x10^{-6}$)		164
Fabric filter	Recycled No. 2 fuel oil	23[b]	Copper	4	A	$3.7x10^{-7}$ ($7.5x10^{-7}$)		339
Fabric filter	Waste oil	30	Copper	3	A	$3.1x10^{-6}$ ($6.1x10^{-6}$)		25
Fabric filter	No. 2 fuel oil	18[c]	Copper	3	A	$5.0x10^{-7}$ ($1.0x10^{-6}$)		340
Fabric filter	Natural gas	0	Hexavalent chromium	2	C	$2.3x10^{-7}$ ($4.5x10^{-7}$)	$2.3x10^{-7}$ ($4.5x10^{-7}$), E	163
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Hexavalent chromium~~	~~3~~	~~D~~	~~$2.9x10^{-7}$ ($5.8x10^{-7}$)~~		~~142~~
Fabric filter	Propane	ND	Lead	3	B	$3.1x10^{-7}$ ($6.2x10^{-7}$)	$3.1x10^{-7}$ ($6.2x10^{-7}$), E	35
Fabric filter	No. 2 fuel oil	0	Lead	3	A	$2.0x10^{-6}$ ($4.1x10^{-6}$)	$7.4x10^{-6}$ ($1.5x10^{-5}$), C	164
Venturi scrubber	No. 2 fuel oil	0	Lead	4	B	$2.6x10^{-6}$ ($5.3x10^{-6}$)		162
Fabric filter	No. 4/6 fuel oil	24	Lead	3	B	$1.9x10^{-6}$ ($3.8x10^{-6}$)		301
Fabric filter	No. 4 fuel oil	10	Lead	2	B	$4.0x10^{-6}$ ($8.0x10^{-6}$)		315
Fabric filter	No. 4 waste oil	0	Lead	3	A	$6.0x10^{-7}$ ($1.2x10^{-6}$)		178
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Lead~~	~~3~~	~~D~~	~~$7.1x10^{-5}$ (0.00014)~~		~~142~~
Fabric filter	Waste oil	30	Lead	3	A	$3.0x10^{-6}$ ($6.0x10^{-6}$)		25
Venturi scrubber	Waste oil	0	Lead	3,3	B,A	$5.2x10^{-5}$ (0.00010)		179, 183
Fabric filter	Recycled No. 2 fuel oil	23[b]	Lead	4	A	$1.6x10^{-6}$ ($3.2x10^{-6}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Lead	3	A	$3.0x10^{-7}$ ($6.1x10^{-7}$)		340
Fabric filter	Natural gas	0	Manganese	3	A	$7.4x10^{-6}$ ($1.5x10^{-5}$)	$7.7x10^{-6}$ ($1.6x10^{-5}$), D	163
Fabric filter	No. 2 fuel oil	0	Manganese	3	A	$1.5x10^{-5}$ ($3.1x10^{-5}$)		164
Venturi scrubber	No. 2 fuel oil	0	Manganese	2	B	$9.3x10^{-6}$ ($1.9x10^{-5}$)		162
Fabric filter	Waste oil	30	Manganese	3	A	$5.5x10^{-6}$ ($1.1x10^{-5}$)		25
Fabric filter	Recycled No. 2 fuel oil	23[b]	Manganese	4	A	$4.2x10^{-6}$ ($8.4x10^{-6}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Manganese	3	A	$4.1x10^{-6}$ ($8.3x10^{-6}$)		340
Fabric filter	Propane	ND	Mercury	3	B	$3.7x10^{-9}$ ($7.3x10^{-9}$)	$1.2x10^{-7}$ ($2.4x10^{-7}$), E	35
Fabric filter	Natural gas	0	Mercury	3	A	$2.4x10^{-7}$ ($4.7x10^{-7}$)		163
Venturi scrubber	No. 2 fuel oil	0	Mercury	2	B	$2.0x10^{-6}$ ($4.0x10^{-6}$)	$1.3x10^{-6}$ ($2.6x10^{-6}$), D	162
Fabric filter	No. 2 fuel oil	0	Mercury	3	A	$2.9x10^{-6}$ ($5.7x10^{-6}$)		164
Fabric filter	Recycled No. 2 fuel oil	23[b]	Mercury	4	A	$2.4x10^{-7}$ ($4.8x10^{-7}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Mercury	3	B	0 (0)		340

Table 4-16 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter	Natural gas	0	Nickel	3	A	$4.8x10^{-6}$ ($9.6x10^{-6}$)	$3.2x10^{-5}$ ($6.3x10^{-5}$), D	163
Fabric filter	No. 2 fuel oil	0	Nickel	3	A	0.00015 (0.00029)		164
~~Venturi scrubber~~	~~No. 5 fuel oil~~	~~35~~	~~Nickel~~	~~3~~	~~D~~	~~$2.0x10^{-6}$ ($4.1x10^{-6}$)~~		~~142~~
Fabric filter	Waste oil	30	Nickel	3	A	$7.5x10^{-6}$ ($1.5x10^{-5}$)		25
Fabric filter	Recycled No. 2 fuel oil	23[b]	Nickel	4	A	$1.1x10^{-7}$ ($2.1x10^{-7}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Nickel	3	A	$3.7x10^{-7}$ ($7.4x10^{-7}$)		340
Fabric filter	Waste oil	30	Phosphorus	3	A	$2.8x10^{-5}$ ($5.5x10^{-5}$)	$1.4x10^{-5}$ ($2.8x10^{-5}$), D	25
Fabric filter	Recycled No. 2 fuel oil	23[b]	Phosphorus	4	A	$8.5x10^{-6}$ ($1.7x10^{-5}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Phosphorus	3	A	$5.8x10^{-6}$ ($1.2x10^{-5}$)		340
Fabric filter	Waste oil	30	Silver	3	A	$7.0x10^{-7}$ ($1.4x10^{-6}$)	$2.4x10^{-7}$ ($4.8x10^{-7}$), E	25
Fabric filter	Recycled No. 2 fuel oil	23[b]	Silver	4	B	$6.6x10^{-9}$ ($1.3x10^{-8}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Silver	3	B	$8.4x10^{-9}$ ($1.7x10^{-8}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Selenium	4	A	$1.1x10^{-7}$ ($2.2x10^{-7}$)	$1.7x10^{-7}$ ($3.5x10^{-7}$), E	339
Fabric filter	No. 2 fuel oil	18[c]	Selenium	3	A	$2.3x10^{-7}$ ($4.7x10^{-7}$)		340
Fabric filter	Recycled No. 2 fuel oil	23[b]	Thallium	4	B	$4.1x10^{-9}$ ($8.2x10^{-9}$)	$2.1x10^{-9}$ ($4.1x10^{-9}$), E	339
Fabric filter	No. 2 fuel oil	18[c]	Thallium	3	B	0 (0)		340
Fabric filter	Propane	ND	Zinc	3	B	$1.6x10^{-5}$ ($3.1x10^{-5}$)	$3.1x10^{-5}$ ($6.1x10^{-5}$), C	35
Fabric filter	Natural gas	0	Zinc	3	A	$2.0x10^{-5}$ ($4.0x10^{-5}$)		163
Fabric filter	No. 2 fuel oil	0	Zinc	3	A	0.00012 (0.00023)		164
Venturi scrubber	No. 2 fuel oil	0	Zinc	2	B	$3.3x10^{-5}$ ($6.6x10^{-5}$)		162
Fabric filter	Recycled No. 2 fuel oil	23[b]	Zinc	4	A	$3.1x10^{-6}$ ($6.3x10^{-6}$)		339
Fabric filter	No. 2 fuel oil	18[c]	Zinc	3	A	$1.6x10^{-6}$ ($3.1x10^{-6}$)		340
Fabric filter	Waste oil	30	Zinc	3	A	$2.7x10^{-5}$ ($5.3x10^{-5}$)		25
~~None~~	~~No. 2 fuel oil~~	~~18[c]~~	~~Antimony~~	~~3~~	~~B~~	~~0 (0)~~		~~340~~
None	No. 2 fuel oil	18[c]	Arsenic	3	A	$6.4x10^{-7}$ ($1.3x10^{-6}$)	$6.4x10^{-7}$ ($1.3x10^{-6}$), E	340
None	No. 2 fuel oil	18[c]	Barium	3	A	0.00013 (0.00025	0.00013 (0.00025), E	340
None	No. 2 fuel oil	18[c]	Beryllium	3	B	0 (0)	0 (0), E	340
None	No. 2 fuel oil	18[c]	Cadmium	3	A	$2.1x10^{-6}$ ($4.2x10^{-6}$)	$2.1x10^{-6}$ ($4.2x10^{-6}$), E	340
None	No. 2 fuel oil	18[c]	Chromium	3	A	$1.2x10^{-5}$ ($2.4x10^{-5}$)	$1.2x10^{-5}$ ($2.4x10^{-5}$), E	340

Table 4-16 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
None	No. 2 fuel oil	18[c]	Cobalt	3	A	$7.6x10^{-6}$ ($1.5x10^{-5}$)	$7.6x10^{-6}$ ($1.5x10^{-5}$), E	340
None	No. 2 fuel oil	18[c]	Copper	3	A	$8.6x10^{-5}$ (0.00017)	$8.6x10^{-5}$ (0.00017), E	340
None	No. 2 fuel oil	18[c]	Lead[d]	3	A	$1.2x10^{-5}$ ($2.3x10^{-5}$)	0.00027 (0.00054), E	340
None	No. 2 fuel oil	18[c]	Manganese	3	A	0.00033 (0.00065)	0.00033 (0.00065), E	340
~~None~~	~~No. 2 fuel oil~~	~~18[c]~~	~~Mercury~~	~~3~~	~~B~~	~~0 (0)~~		~~340~~
None	No. 2 fuel oil	18[c]	Nickel[d]	3	A	$7.7x10^{-6}$ ($1.5x10^{-5}$)	0.00065 (0.0013), E	340
None	No. 2 fuel oil	18[c]	Phosphorus	3	A	0.00060 (0.0012)	0.00060 (0.0012), E	340
None	No. 2 fuel oil	18[c]	Selenium[d]	3	B	$5.8x10^{-8}$ ($1.2x10^{-7}$)	$1.2x10^{-6}$ ($2.4x10^{-6}$), E	340
~~None~~	~~No. 2 fuel oil~~	~~18[c]~~	~~Silver~~	~~3~~	~~A~~	~~1.3E-07 (2.7E-07)~~		~~340~~
None	No. 2 fuel oil	18[c]	Thallium	3	A	$1.1x10^{-6}$ ($2.2x10^{-6}$)	$1.1x10^{-6}$ ($2.2x10^{-6}$), E	340
None	No. 2 fuel oil	18[c]	Zinc	3	A	$9.2x10^{-5}$ (0.00018)	$9.2x10^{-5}$ (0.00018), E	340

ND = no data available

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b] Facility processed 23 percent RAP during Runs 1, 2, and 3, and no RAP during Run 4.

[c] Facility processed 18 percent RAP during Runs 1 and 2 and no RAP during Run 3.

[d] Uncontrolled emission data are inconsistent with controlled emissions data for this pollutant. Therefore, emission factor is based on the control efficiency measured during Reference 340 test applied to controlled emission factor for this pollutant.

Table 4-17. SUMMARY OF EMISSION FACTOR DEVELOPMENT
FOR ORGANIC COMPOUNDS; DRUM MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	1-Pentene	4	B	0.00017 (0.00033)	0.0011 (0.0022), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	1-Pentene	3	A	0.0021 (0.0041)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	2-Methyl-1-pentene	4	A	0.0020 (0.0040)	0.0020 (0.0040), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	2-Methyl-2-butene	3	B	0.000031 (6.1E-05)	0.00029 (0.00058), E	340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	2-Methyl-2-butene	4	B	0.00055 (0.0011)		339
Fabric filter[b]	No. 2 fuel oil	35	2-Methylnaphthalene	3	A	8.5E-05 (0.00017)	8.5E-05 (0.00017), E	50
Fabric filter[b]	Natural gas	13	2-Methylnaphthalene	3	A	1.7E-05 (3.3E-05)	3.7E-05 (7.4E-05), D	45
Fabric filter[b]	Natural gas	30	2-Methylnaphthalene	3	A	2.5E-05 (4.9E-05)		44
Fabric filter[b]	Natural gas	0	2-Methylnaphthalene	3	A	7.0E-05 (0.00014)		48
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	3-Methylpentane	4	B	8.0E-05 (0.00016)	9.5E-05 (0.00019), D	339
Fabric filter[b]	No. 2 fuel oil	18[d]	3-Methylpentane	3	B	0.00011 (0.00022)		340
Fabric filter[b]	Natural gas	0	Acenaphthene	3	A	1.1E-06 (2.2E-06)	6.9E-7 (1.4E-6), E	48
Fabric filter[b]	Propane	ND	Acenaphthene	3	B	2.9E-07 (5.7E-07)		35
Fabric filter[b]	No. 2 fuel oil	35	Acenaphthylene	3	A	1.1E-05 (2.2E-05)	1.1E-5 (2.2E-5), E	50
Fabric filter[b]	Natural gas	13	Acenaphthylene	3	A	1.2E-05 (2.3E-05)	4.3E-6 (8.6E-6), D	45
Fabric filter[b]	Natural gas	0	Acenaphthylene	3	A	1.4E-06 (2.7E-06)		48
Fabric filter[b]	Propane	ND	Acenaphthylene	3	B	5.0E-08 (1.0E-07)		35
Fabric filter[b]	Waste oil	30	Acetaldehyde	4	A	0.00065 (0.0013)	0.00065 (0.0013), E	25
Fabric filter[b]	Waste oil	30	Acetone	4	A	0.00042 (0.00083)	0.00042 (0.00083), E	25
Fabric filter[b]	Waste oil	30	Acrolein	4	A	1.3E-05 (2.6E-05)	1.3E-5 (2.6E-5), E	25
Fabric filter[b]	No. 2 fuel oil	35	Anthracene	3	A	1.8E-06 (3.6E-06)	1.5E-6 (3.1E-06), E	50
Fabric filter[b]	No. 2 fuel oil	0	Anthracene	2	C	1.3E-06 (2.5E-06)		162
Fabric filter[b]	Natural gas	0	Anthracene	3	A	1.8E-07 (3.6E-07)	1.1E-07 (2.2E-07), E	48
Fabric filter[b]	Propane	ND	Anthracene	3	B	3.7E-08 (7.3E-08)		35
Fabric filter[b]	Waste oil	30	Benzaldehyde	4	A	5.5E-05 (0.00011)	5.5E-05 (0.00011), E	25
Fabric filter[b]	Drain oil	10	Benzene	3	A	4.6E-05 (9.2E-05)	0.00020 (0.00039), A	346
Fabric filter[b]	Drain oil	24	Benzene	3	A	6.1E-05 (0.00012)		344
Fabric filter[b]	Drain oil	20	Benzene	3	A	6.2E-05 (0.00012)		377

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Natural gas	20	Benzene	3	A	0.00018 (0.00036)		342
Fabric filter[b]	Waste oil	20	Benzene	3	A	3.2E-05 (6.3E-05)		349
Fabric filter[b]	Drain oil	10	Benzene	3	A	7.7E-05 (0.00015)		345
Fabric filter[b]	Natural gas	15	Benzene	3	A	0.00011 (0.00022)		383
Fabric filter[b]	Drain oil	0	Benzene	3	A	0.00013 (0.00026)		347
Fabric filter[b]	Natural gas	23	Benzene	3	A	0.00014 (0.00027q)		384
Fabric filter[b]	Drain oil	10	Benzene	3	A	0.00015 (0.00029)		351
Fabric filter[b]	No. 2 fuel oil	35	Benzene	9	C	0.00015 (0.00030)		50
Fabric filter[b]	Drain oil	25	Benzene	3	B	0.00019 (0.00038)		373
Fabric filter[b]	Natural gas	13	Benzene	2	B	0.00020 (0.00040)		45
Fabric filter[b]	Waste oil	30	Benzene	19	B	0.00021 (0.00041)		25
Fabric filter[b]	Natural gas	20	Benzene	3	A	0.00022 (0.00044)		341
Fabric filter[b]	Drain oil	20	Benzene	3	A	0.00028 (0.00056)		376
Fabric filter[b]	~~Natural gas~~	~~0~~	~~Benzene~~	~~3~~	C[e]	~~0.00033 (0.00066)~~		~~48~~
Fabric filter[b]	Waste oil	0	Benzene	3	A	0.00035 (0.00069)		348
Fabric filter[b]	Drain oil and natural gas	20	Benzene	3	A	0.00055 (0.0011)		350
Fabric filter[b]	Natural gas	30	Benzene	3	A	0.00060 (0.0012)		44
Fabric filter[b]	Natural gas	0	Benzo(a)anthracene	3	A	1.1E-07 (2.1E-07)	1.0E-07 (2.1E-07), E	48
Fabric filter[b]	Natural gas	0	Benzo(a)pyrene	3	A	4.9E-09 (9.8E-09)	4.9E-09 (9.8E-09), E	48
Fabric filter[b]	Natural gas	0	Benzo(b)fluoranthene	3	A	7.5E-08 (1.5E-07)	5.2E-08 (1.0E-07), E	48
Fabric filter[b]	Propane	ND	Benzo(b)fluoranthene	3	B	2.8E-08 (5.6E-08)		35
Fabric filter[b]	Natural gas	0	Benzo(e)pyrene	3	A	5.5E-08 (1.1E-07)	5.4E-08 (1.1E-07), E	48
Fabric filter[b]	Natural gas	0	Benzo(g,h,i)perylene	3	A	2.0E-08 (4.0E-08)	2.0E-08 (4.0E-08), E	48
Fabric filter[b]	Natural gas	0	Benzo(k)fluoranthene	3	A	2.7E-08 (5.4E-08)	2.0E-08 (4.1E-08), E	48
Fabric filter[b]	Propane	ND	Benzo(k)fluoranthene	3	C	1.4E-08 (2.7E-08)		35
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Butane	4	B	0.00034 (0.00067)	0.00034 (0.00067), E	339
Fabric filter[b]	Waste oil	30	Butyraldehyde/ isobutyraldehyde	4	A	0.000080 (0.00016)	8.0E-05 (0.00016), E	25
Fabric filter[b]	Drain oil	10	Chlorobenzene	3	NR	BDL	BDL	345
Fabric filter[b]	Drain oil and natural gas	20	Chlorobenzene	3	NR	BDL		350
Fabric filter[b]	Drain oil	10	Chlorobenzene	3	NR	BDL		351
Fabric filter[b]	Natural gas	20	Chlorobenzene	3	NR	BDL		342
Fabric filter[b]	Natural gas	0	Chrysene	3	A	1.8E-07 (3.6E-07)	9.1E-08 (1.8E-07), E	48
Fabric filter[b]	Propane	ND	Chrysene	3	C	2.7E-09 (5.4E-09)		35

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Waste oil	30	Crotonaldehyde	4	A	4.3E-05 (8.6E-05)	4.3E-05 (8.6E-05), E	25
Fabric filter[b]	Natural gas	0	Cumene	3	A	2.2E-05 (4.3E-05)	2.1E-05 (4.3E-05), E	48
Fabric filter[b]	Drain oil	10	Dichlorobenzene	3	NR	BDL	BDL	345
Fabric filter[b]	Drain oil	20	Dichlorobenzene	3	NR	BDL		342
Fabric filter[b]	Drain oil and natural gas	20	Dichlorobenzene	3	NR	BDL		350
Fabric filter[b]	Drain oil	10	Dichlorobenzene	3	NR	BDL		351
Fabric filter[b]	Natural gas	13	Ethylbenzene	3	C	2.6E-05 (5.1E-05)	0.00012 (0.00024), D	45
Fabric filter[b]	Natural gas	30	Ethylbenzene	2	B	0.00015 (0.00029)		44
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~35~~	~~Ethylbenzene~~	~~9~~	C[e]	~~0.00019 (0.00038)~~		~~50~~
Fabric filter[b]	Waste oil	30	Ethylbenzene	19	B	0.00019 (0.00038)		25
~~Fabric filter[b]~~	~~Natural gas~~	~~0~~	~~Ethylbenzene~~	~~3~~	C[e]	~~0.00045 (0.00090)~~		~~48~~
Fabric filter[b]	No. 2 fuel oil	18[d]	Ethylene	3	A	0.0033 (0.0066)	0.0035 (0.0070), E	340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Ethylene	4	A	0.0037 (0.0073)		339
Fabric filter[b]	Propane	ND	Fluoranthene	3	B	8.5E-09 (1.7E-08)	3.1E-07 (6.1E-07), D	35
Fabric filter[b]	Natural gas	13	Fluoranthene	3	A	3.6E-07 (7.2E-07)		45
Fabric filter[b]	Natural gas	0	Fluoranthene	3	A	5.5E-07 (1.1E-06)		48
Fabric filter[b]	No. 2 fuel oil	35	Fluorene	3	A	8.5E-06 (1.7E-05)	5.3E-06 (1.1E-05), E	50
Fabric filter[b]	No. 2 fuel oil	0	Fluorene	3	A	2.1E-06 (4.1E-06)		164
Fabric filter[b]	Natural gas	13	Fluorene	3	A	4.9E-06 (9.8E-06)	1.9E-06 (3.8E-06), D	45
Fabric filter[b]	Natural gas	0	Fluorene	3	A	1.3E-06 (2.5E-06)		48
Fabric filter[b]	Natural gas	0	Fluorene	3	A	1.1E-06 (2.2E-06)		163
Fabric filter[b]	Propane	ND	Fluorene	3	B	4.1E-07 (8.1E-07)		35
Fabric filter[b]	Natural gas	15	Formaldehyde	3	A	0.00015 (0.00030)	0.0016 (0.0031), A	383
Fabric filter[b]	Natural gas	23[c]	Formaldehyde	3	A	0.00023 (0.00046)		343
Fabric filter[b]	Waste oil	0	Formaldehyde	3	A	0.00029 (0.00057)		348
Fabric filter[b]	Waste oil	20	Formaldehyde	3	A	0.00033 (0.00066)		349
Fabric filter[b]	Propane	ND	Formaldehyde	3	B	0.00034 (0.00067)		35
Fabric filter[b]	Drain oil	24	Formaldehyde	3	A	0.00046 (0.00091)		344
Fabric filter[b]	Waste oil	0	Formaldehyde	3	A	0.00059 (0.0012)		388
Fabric filter[b]	Natural gas	23	Formaldehyde	3	A	0.00066 (0.0013)		384
Fabric filter[b]	Drain oil	25	Formaldehyde	3	A	0.00073 (0.0015)		373
Fabric filter[b]	Natural gas	13	Formaldehyde	3	A	0.00080 (0.0016)		45
Fabric filter[b]	Waste oil	30	Formaldehyde	4	A	0.0010 (0.0020)		25

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	No. 2 fuel oil	18[d]	Formaldehyde	3	B	0.0011 (0.0021)		340
Fabric filter[b]	Natural gas	20	Formaldehyde	3	A	0.0011 (0.0021)		342
Fabric filter[b]	Drain oil	20	Formaldehyde	3	A	0.0012 (0.0023)		375
Fabric filter[b]	Drain oil	0	Formaldehyde	3	A	0.0013 (0.0026)		347
Fabric filter[b]	No. 2 fuel oil	35	Formaldehyde	3	A	0.0014 (0.0027)		50
Fabric filter[b]	Natural gas	20	Formaldehyde	3	A	0.0024 (0.0047)		341
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Formaldehyde	4	A	0.0026 (0.0051)		339
Fabric filter[b]	Natural gas	0	Formaldehyde	3	A	0.0043 (0.0086)		44
Fabric filter[b]	Drain oil	24	Formaldehyde	3	A	0.0052 (0.010)		371
Fabric filter[b]	Drain oil	25	Formaldehyde	3	A	0.0071 (0.014)		372
~~Fabric filter[b]~~	~~Waste oil~~	~~0~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00021 (0.00041)~~		~~40~~
~~Fabric filter[b]~~	~~Natural gas~~	~~0~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00022 (0.00043)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~0~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00022 (0.00043)~~		~~40~~
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~29~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00031 (0.00062)~~		~~141~~
~~Fabric filter[b]~~	~~ND~~	~~0~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00032 (0.00063)~~		~~40~~
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~40~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00033 (0.00065)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~0~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00034 (0.00067)~~		~~40~~
~~Fabric filter[b]~~	~~ND~~	~~45~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00047 (0.00094)~~		~~40~~
~~Fabric filter[b]~~	~~ND~~	~~20~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00065 (0.0013)~~		~~40~~
~~Fabric filter[b]~~	~~Natural gas~~	~~31~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00080 (0.0016)~~		~~146~~
~~Fabric filter[b]~~	~~Waste oil~~	~~25~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00090 (0.0018)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~40~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0019 (0.0038)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~52~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0020 (0.0040)~~		~~40~~
~~Fabric filter[b]~~	~~Natural gas~~	~~30~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0023 (0.0046)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~35~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0033 (0.0066)~~		~~40~~
~~Fabric filter[b]~~	~~Waste oil~~	~~40~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0036 (0.0071)~~		~~40~~
Fabric filter[b]	Drain oil and natural gas	20	Sulfuric acid	3	A	0.00014 (0.00028)	0.00065 (0.0013), E	350
Fabric filter[b]	Drain oil	10	Sulfuric acid	3	A	0.0012 (0.0023)		351
Fabric filter[b]	Drain oil	15	Hydrochloric acid	3	A	1.9E-05 (3.8E-05)	0.00010 (0.00021), D	379
Fabric filter[b]	Drain oil	0	Hydrochloric acid	3	A	2.0E-05 (3.9E-05)		376
Fabric filter[b]	Drain oil	0	Hydrochloric acid	3	A	8.8E-05 (0.00018)		380
Fabric filter[b]	Drain oil	0	Hydrochloric acid	3	A	0.00016 (0.00032)		374
Fabric filter[b]	Waste oil	0	Hydrochloric acid	3	A	0.00022 (0.00045)		348

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Heptane	4	B	0.00036 (0.00072)	0.0047 (0.0094), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Heptane	3	A	0.0090 (0.018)		340
Fabric filter[b]	Waste oil	30	Hexanal	4	A	0.000055 (0.00011)	5.5E-05 (0.00011), E	25
Fabric filter[b]	No. 2 fuel oil	18[d]	Hexane	3	B	0 (0)	0.00046 (0.00092), E	340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Hexane	4	A	0.00090 (0.0018)		339
Fabric filter[b]	Natural gas	0	Indeno(1,2,3-cd)pyrene	3	A	3.5E-09 (7.0E-09)	3.5E-09 (7.0E-09), E	48
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Isooctane	4	B	1.6E-05 (3.1E-05)	2.0E-05 (4.0E-05), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Isooctane	3	B	2.4E-05 (4.8E-05)		340
Fabric filter[b]	Waste oil	30	Isovaleraldehyde	4	A	1.6E-05 (3.2E-05)	1.6E-05 (3.2E-05), E	25
Fabric filter[b]	Propane	ND	Methyl chloroform	3	C	2.4E-05 (4.8E-05)	2.4E-05 (4.8E-05), E	35
Fabric filter[b]	Waste oil	30	Methyl ethyl ketone	4	B	1.0E-05 (2.0E-05)	1.0E-05 (2.0E-05), E	25
Fabric filter[b]	No. 2 fuel oil	35	Naphthalene	3	A	7.5E-05 (0.00015)	0.00033 (0.00065), D	50
Fabric filter[b]	No. 2 fuel oil	0	Naphthalene	3	A	0.00014 (0.00028)		164
Fabric filter[b]	No. 2 fuel oil	0	Naphthalene	2	B	0.00085 (0.0017)		162
Fabric filter[b]	Waste oil	30	Naphthalene	3	A	0.00024 (0.00047)		25
Fabric filter[b]	Propane	ND	Naphthalene	3	B	6.0E-06 (1.2E-05)	4.5E-05 (9.0E-05), D	35
Fabric filter[b]	Natural gas	30	Naphthalene	3	A	2.7E-05 (5.3E-05)		44
Fabric filter[b]	Natural gas	0	Naphthalene	3	A	2.9E-05 (5.7E-05)		48
Fabric filter[b]	Natural gas	13	Naphthalene	3	A	3.5E-05 (7.0E-05)		45
Fabric filter[b]	Natural gas	0	Naphthalene	3	A	0.00013 (0.00026)		163
Fabric filter[b]	No. 2 fuel oil	18[d]	n-Pentane	3	B	0.00011 (0.00021)	0.00011 (0.00021), E	340
Fabric filter[b]	Natural gas	0	Perylene	2	B	4.4E-09 (8.8E-09)	4.4E-09 (8.8E-09), E	48
Fabric filter[b]	No. 2 fuel oil	35	Phenanthrene	3	A	2.8E-05 (5.5E-05)	1.2E-05 (2.3E-05), D	50
Fabric filter[b]	No. 2 fuel oil	0	Phenanthrene	2	B	5.5E-06 (1.1E-05)		162
Fabric filter[b]	No. 2 fuel oil	0	Phenanthrene	3	A	1.7E-06 (3.3E-06)		164
Fabric filter[b]	Propane	ND	Phenanthrene	3	B	1.8E-06 (3.6E-06)	3.8E-06 (7.6E-06), D	35
Fabric filter[b]	Natural gas	0	Phenanthrene	3	A	1.9E-06 (3.8E-06)		163

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Natural gas	13	Phenanthrene	3	A	3.3E-06 (6.6E-06)		45
Fabric filter[b]	Natural gas	30	Phenanthrene	3	A	5.0E-06 (1.0E-05)		44
Fabric filter[b]	Natural gas	0	Phenanthrene	3	A	7.0E-06 (1.4E-05)		48
Fabric filter[b]	Waste oil	30	Propionaldehyde	4	A	6.5E-05 (0.00013)	6.5E-05 (0.00013), E	25
Fabric filter[b]	No. 2 fuel oil	35	Pyrene	2	B	1.5E-06 (3.0E-06)	1.5E-06 (3.0E-06), E	50
Fabric filter[b]	Propane	ND	Pyrene	3	B	1.5E-08 (2.9E-08)	2.7E-07 (5.4E-07), D	35
Fabric filter[b]	Natural gas	13	Pyrene	2	B	3.5E-07 (6.9E-07)		45
Fabric filter[b]	Natural gas	0	Pyrene	3	A	4.5E-07 (9.0E-07)		48
Fabric filter[b]	Waste oil	30	Quinone	4	A	8.0E-05 (0.00016)	8.0E-05 (0.00016), E	25
Fabric filter[b]	No. 2 fuel oil	35	Toluene	9	C	0.00015 (0.00029)	0.0015 (0.0029), D	50
Fabric filter[b]	Waste oil	30	Toluene	19	B	0.00038 (0.00075)		25
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Toluene	4	B	0.0016 (0.0031)		339
Fabric filter[b]	No. 2 fuel oil	18[d]	Toluene	3	B	0.0037 (0.0074)		340
Fabric filter[b]	Natural gas	13	Toluene	3	C	2.3E-05 (4.5E-05)	7.3E-05 (0.00015), D	45
Fabric filter[b]	Propane	ND	Toluene	3	B	8.5E-05 (0.00017)		35
Fabric filter[b]	Natural gas	30	Toluene	3	A	0.00011 (0.00022)		44
Fabric filter[b]	~~Natural gas~~	~~0~~	~~Toluene~~	~~3~~	C[e]	~~0.00039 (0.00078)~~		~~48~~
Fabric filter[b]	Drain oil	10	Trichlorobenzene	3	NR	BDL	BDL	345
Fabric filter[b]	Drain oil and natural gas	20	Trichlorobenzene	3	NR	BDL		350
Fabric filter[b]	Drain oil	10	Trichlorobenzene	3	NR	BDL		351
Fabric filter[b]	Waste oil	30	Valeraldehyde	4	A	3.4E-05 (6.7E-05)	3.4E-05 (6.7E-05), E	25
Fabric filter[b]	Natural gas	13	Xylene	3	C	2.6E-05 (5.1E-05)	0.00010 (0.00020), D	45
Fabric filter[b]	Waste oil	30	Xylene	19	B	8.0E-05 (0.00016)		25
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~35~~	~~Xylene~~	~~9~~	C[e]	~~0.00017 (0.00034)~~		~~50~~
Fabric filter[b]	Natural gas	30	Xylene	3	A	0.00020 (0.00040)		44
~~Fabric filter[b]~~	~~Natural gas~~	~~0~~	~~Xylene~~	~~3~~	C[e]	~~0.00045 (0.00090)~~		~~48~~
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~1234678 HpCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	2.4E-12 (4.8E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	1234678 HpCDD	4	B	2.4E-12 (4.8E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~1234678 HpCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	3.3E-12 (6.5E-12) ,E	~~340~~

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	1234678 HpCDF	4	A	3.3E-12 (6.5E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~123478 HxCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	2.1E-13 (4.2E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	123478 HxCDD	4	B	2.1E-13 (4.2E-13)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~123478 HxCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	2.0E-12 (4.0E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	123478 HxCDF	4	A	2.0E-12 (4.0E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~1234789 HpCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	1.4E-12 (2.7E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	1234789 HpCDF	4	A	1.4E-12 (2.7E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~123678 HxCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	6.5E-13 (1.3E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	123678 HxCDD	4	B	6.5E-13 (1.3E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~123678 HxCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	5.8E-13 (1.2E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	123678 HxCDF	4	A	5.8E-13 (1.2E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~12378 PeCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	1.6E-13 (3.1E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	12378 PeCDD	4	B	1.6E-13 (3.1E-13)		339
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	12378 PeCDF	4	B	2.1E-13 (4.2E-13)	2.2E-12 (4.3E-12), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	12378 PeCDF	3	B	4.1E-12 (8.2E-12)		340
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~123789 HxCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	4.9E-13 (9.8E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	123789 HxCDD	4	B	4.9E-13 (9.8E-13)		339
~~Fabric filter[b]~~	~~Recycled No. 2 fuel oil~~	~~23[c]~~	~~123789 HxCDF~~	~~4~~	~~B~~	~~BDL (BDL)~~	4.2E-12 (8.4E-12), E	~~339~~

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	No. 2 fuel oil	18[d]	123789 HxCDF	3	B	4.2E-12 (8.4E-12)		340
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~234678 HxCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	9.5E-13 (1.9E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	234678 HxCDF	4	A	9.5E-13 (1.9E-12)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~23478 PeCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	4.2E-13 (8.4E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	23478 PeCDF	4	B	4.2E-13 (8.4E-13)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~2378 TCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	1.1E-13 (2.1E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	2378 TCDD	4	B	1.1E-13 (2.1E-13)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~2378 TCDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	4.8E-13 (9.7E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	2378 TCDF	4	B	4.8E-13 (9.7E-13)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~Octa CDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	1.2E-11 (2.5E-11), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Octa CDD	4	A	1.2E-11 (2.5E-11)		339
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~Octa CDF~~	~~3~~	~~B~~	~~BDL (BDL)~~	2.4E-12 (4.8E-12), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Octa CDF	4	A	2.4E-12 (4.8E-12)		339
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total HpCDD	4	B	3.4E-12 (6.9E-12)	9.7E-12 (1.9E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total HpCDD	3	B	1.6E-11 (3.2E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total HpCDF	4	A	3.7E-12 (7.4E-12)	5.2E-12 (1.0E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total HpCDF	3	B	6.6E-12 (1.3E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total HxCDD	4	B	5.0E-12 (1.0E-11)	6.1E-12 (1.2E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total HxCDD	3	B	7.1E-12 (1.4E-11)		340

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total HxCDF	4	B	5.7E-12 (1.2E-11)	6.5E-12 (1.3E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total HxCDF	3	B	7.3E-12 (1.5E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total PCDD	4	B	2.3E-11 (4.5E-11)	4.0E-11 (7.9E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total PCDD	3	B	4.4E-11 (8.8E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total PCDD/PCDF	4	B	3.8E-11 (7.5E-11)	6.0E-11 (1.2E-10), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total PCDD/PCDF	3	B	6.7E-11 (1.3E-10)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total PCDF	4	B	1.5E-11 (3.0E-11)	2.0E-11 (4.0E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total PCDF	3	B	2.3E-11 (4.6E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total PeCDD	4	A	1.3E-12 (2.6E-12)	1.1E-11 (2.2E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total PeCDD	3	B	2.1E-11 (4.2E-11)		340
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total PeCDF	4	B	1.6E-12 (3.2E-12)	4.2E-12 (8.4E-11), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total PeCDF	3	B	6.8E-12 (1.4E-11)		340
~~Fabric filter[b]~~	~~No. 2 fuel oil~~	~~18[d]~~	~~Total TCDD~~	~~3~~	~~B~~	~~BDL (BDL)~~	4.7E-13 (9.3E-13), E	~~340~~
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total TCDD	4	A	4.7E-13 (9.3E-13)		339
Fabric filter[b]	Recycled No. 2 fuel oil	23[c]	Total TCDF	4	B	1.5E-12 (3.0E-12)	1.9E-12 (3.7E-12), E	339
Fabric filter[b]	No. 2 fuel oil	18[d]	Total TCDF	3	B	2.2E-12 (4.5E-12)		340
None	No. 2 fuel oil	18[e]	2,3,7,8-TCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	Total TCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDD	3	B	ND (ND)	ND (ND)	340

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
None	No. 2 fuel oil	18[e]	Total PeCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDD	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	Total HxCDD	3	B	2.7E-12 (5.4E-12)	2.7E-12 (5.4E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDD	3	B	1.7E-11 (3.4E-11)	1.7E-11 (3.4E-11)	340
None	No. 2 fuel oil	18[e]	Total HpCDD	3	B	3.5E-11 (7.1E-11)	3.5E-11 (7.1E-11)	340
None	No. 2 fuel oil	18[e]	Octa CDD	3	B	1.4E-9 (2.7E-9)	1.4E-9 (2.7E-9)	340
None	No. 2 fuel oil	18[e]	Total PCDD	3	B	1.4E-9 (2.8E-9)	1.4E-9 (2.8E-9)	340
None	No. 2 fuel oil	18[e]	2,3,7,8-TCDF	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	Total TCDF	3	B	1.7E-11 (3.3E-11)	1.7E-11 (3.3E-11)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8-PeCDF	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	2,3,4,7,8-PeCDF	3	B	ND (ND)	ND (ND)	340
None	No. 2 fuel oil	18[e]	Total PeCDF	3	B	3.7E-11 (7.4E-11)	3.7E-11 (7.4E-11)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8-HxCDF	3	B	2.7E-12 (5.4E-12)	2.7E-12 (5.4E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,6,7,8-HxCDF	3	B	ND (ND)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	2,3,4,6,7,8-HxCDF	3	B	8.1E-13 (1.6E-12)	8.1E-13 (1.6E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,7,8,9-HxCDF	3	B	ND (ND)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total HxCDF	3	B	4.1E-12 (8.1E-12)	4.1E-12 (8.1E-12)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,6,7,8-HpCDF	3	B	5.4E-12 (1.1E-11)	5.4E-12 (1.1E-11)	340
None	No. 2 fuel oil	18[e]	1,2,3,4,7,8,9-HpCDF	3	B	ND (ND)	BDL (BDL)	340

Table 4-17 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating[a]	Ref. No.
None	No. 2 fuel oil	18[e]	Total HpCDF	3	B	1.9E-11 (3.8E-11)	1.9E-11 (3.8E-11)	340
None	No. 2 fuel oil	18[e]	Octa CDF	3	B	ND (ND)	BDL (BDL)	340
None	No. 2 fuel oil	18[e]	Total PCDF	3	B	7.7E-11 (1.5E-10)	7.7E-11 (1.5E-10)	340
None	No. 2 fuel oil	18[e]	Total PCDD+PCDF	3	B	1.5E-9 (3.0E-9)	1.5E-9 (3.0E-9)	340

ND = no data available; NR = not rated; BDL = below detection limit.

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b] Control device may provide only incidental control.

[c] Facility processed 23 percent RAP during Runs 1, 2, and 3, and no RAP during Run 4.

[d] Facility processed 18 percent RAP during Runs 1 and 2 and no RAP during Run 3.

[e] These C-rated data are not included in the candidate emission factor because they are based on one-half of the detection limit for non-detect runs; the factors based on one-half of the detection limit are higher than the candidate emission factor based on actual measurements made during other tests.

Table 4-18. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR HOT MIX ASPHALT PLANTS DRUM MIX FACILITY – HOT OIL SYSTEMS

Type of control	Fuel fired	Pollutant	No. of tests	Emission factor rating	Average emission factor, kg/l (lb/gal) fuel consumed, unless noted otherwise	Ref. No.
None	No. 2 fuel oil	Naphthalene	1	E	$2.0x10^{-6}$ ($1.7x10^{-5}$)	35
None	No. 2 fuel oil	Acenaphthylene	1	E	$2.4x10^{-8}$ ($2.0x10^{-7}$)	35
None	No. 2 fuel oil	Acenaphthene	1	E	$6.4x10^{-8}$ ($5.3x10^{-7}$)	35
None	No. 2 fuel oil	Fluorene	1	E	$2.8x10^{-7}$ ($2.3x10^{-6}$)	35
None	No. 2 fuel oil	Phenanthrene	1	E	$5.9x10^{-7}$ ($4.9x10^{-6}$)	35
None	No. 2 fuel oil	Anthracene	1	E	$2.2x10^{-8}$ ($1.8x10^{-7}$)	35
None	No. 2 fuel oil	Fluoranthene	1	E	$5.3x10^{-9}$ ($4.4x10^{-8}$)	35
None	No. 2 fuel oil	Pyrene	1	E	$3.8x10^{-9}$ ($3.2x10^{-8}$)	35
None	No. 2 fuel oil	Benzo(b)fluoranthene	1	E	$1.2x10^{-8}$ ($1.0x10^{-7}$)	35
None	No. 2 fuel oil	TCDF (total)	1	E	$4.0x10^{-13}$ ($3.3x10^{-12}$)	35
None	No. 2 fuel oil	PCDF (total)	1	E	$5.8x10^{-14}$ ($4.8x10^{-13}$)	35
None	No. 2 fuel oil	HxCDF (total)	1	E	$2.4x10^{-13}$ ($2.0x10^{-12}$)	35
None	No. 2 fuel oil	HpCDF (total)	1	E	$1.2x10^{-12}$ ($9.7x10^{-12}$)	35
None	No. 2 fuel oil	1,2,3,4,6,7,8-HpCDF	1	E	$4.2x10^{-13}$ ($3.5x10^{-12}$)	35
None	No. 2 fuel oil	OCDF	1	E	$1.4x10^{-12}$ ($1.2x10^{-11}$)	35
None	No. 2 fuel oil	HxCDD (total)	1	E	$7.4x10^{-13}$ ($6.2x10^{-12}$)	35
None	No. 2 fuel oil	1,2,3,7,8,9-HxCDD	1	E	$9.1x10^{-14}$ ($7.6x10^{-13}$)	35
None	No. 2 fuel oil	1,2,3,4,7,8-HxCDD	1	E	$8.3x10^{-14}$ ($6.9x10^{-13}$)	35
None	No. 2 fuel oil	HpCDD (total)	1	E	$2.4x10^{-12}$ ($2.0x10^{-11}$)	35
None	No. 2 fuel oil	1,2,3,4,6,7,8-HpCDD	1	E	$1.8x10^{-12}$ ($1.5x10^{-11}$)	35
None	No. 2 fuel oil	OCDD	1	E	$1.9x10^{-11}$ ($1.6x10^{-10}$)	35
None	No. 2 fuel oil	Formaldehyde	4	C	$4.2x10^{-7}$ ($3.5x10^{-6}$)	395
None	No. 2 fuel oil	CO	4	C	0.00015 (0.0012)	395
None	No. 2 fuel oil	CO_2	4	C	3.4 (28)	395
None	Natural gas	Formaldehyde	4	C	$4.1x10^{-7}$ kg/m^3 ($2.6x10^{-8}$ lb/ft^3)	395
None	Natural gas	CO	4	C	0.00014 kg/m^3 ($8.9x10^{-6}$ lb/ft^3)	395
None	Natural gas	CO_2	4	C	3.3 kg/m^3 (0.20 lb/ft^3)	395

Table 4-19. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR PM; BATCH MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	ND	Cond. inorganic PM	1	C	0.00036 (0.00073)	0.0065 (0.013), A	239
Fabric filter	No. 6 fuel oil	0	Cond. inorganic PM	3	A	0.00040 (0.00080)		143
Wet cyclone	Natural gas	0	Cond. inorganic PM	2	C	0.00050 (0.0010)		15
Wet scrubber	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.00050 (0.0010)		52
Fabric filter	Propane	ND	Cond. inorganic PM	2	B	0.00059 (0.0012)		165
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.00061 (0.0012)		181
Fabric filter	NA	ND	Cond. inorganic PM	3	C	0.00063 (0.0013)		331
Venturi scrubber	Natural gas	0	Cond. inorganic PM	3	A	0.00093 (0.0019)		145
Fabric filter	Waste oil	ND	Cond. inorganic PM	3	A	0.0011 (0.0021)		385
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	B	0.0012 (0.0025)		261
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0013 (0.0027)		47
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0017 (0.0034)		176
Low-energy scrubber	Natural gas	0	Cond. inorganic PM	3	B	0.0017 (0.0033)		15
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0017 (0.0034)		284
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0018 (0.0037)		281
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0018 (0.0036)		314
Fabric filter	No. 2 fuel oil	0	Cond. inorganic PM	3	A	0.0018 (0.0036)		312
Fabric filter	Natural gas	0	Cond. inorganic PM	3	B	0.0021 (0.0042)		24
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	B	0.0021 (0.0042)		249
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0023 (0.0045)		276
Fabric filter	Natural gas	0	Cond. inorganic PM	2	B	0.0024 (0.0049)		310
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0026 (0.0053)		86
Wet scrubber	Natural gas	0	Cond. inorganic PM	2	C	0.0030 (0.0060)		15
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.0040 (0.0080)		193

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	ND	0	Cond. inorganic PM	2	C	0.0053 (0.011)		100
Venturi scrubber	ND	ND	Cond. inorganic PM	3	C	0.0056 (0.011)		291
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	B	0.0061 (0.012)		213
Fabric filter	Natural gas	0	Cond. inorganic PM	3	A	0.0080 (0.016)		97
Venturi scrubber	No. 2 fuel oil	0	Cond. inorganic PM	2	C	0.0083 (0.017)		15
Fabric filter	ND	10	Cond. inorganic PM	3	C	0.0096 (0.019)		325
Venturi scrubber	ND	ND	Cond. inorganic PM	3	C	0.010 (0.021)		290
Fabric filter	No. 6 fuel oil	30	Cond. inorganic PM	3	A	0.013 (0.026)		49
Fabric filter	No. 2 fuel oil	ND	Cond. inorganic PM	3	A	0.033 (0.066)		170
Fabric filter	Natural gas	ND	Cond. inorganic PM	3	A	0.034 (0.068)		282
Fabric filter	Natural gas	ND	Cond. inorganic PM	3,3	B	0.059 (0.12)		216, 217
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	B	5.9×10^{-6} (1.2×10^{-5})	0.0021 (0.0041), A	249
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	B	5.4×10^{-5} (0.00011)		261
Fabric filter	Natural gas	ND	Cond. organic PM	1	C	0.00013 (0.00027)		239
Fabric filter	Propane	ND	Cond. organic PM	2	B	0.00028 (0.00056)		165
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.00042 (0.00084)		176
Fabric filter	No. 6 fuel oil	0	Cond. organic PM	3	A	0.00058 (0.0012)		143
Fabric filter	Natural gas	0	Cond. organic PM	2	B	0.00061 (0.0012)		24
Fabric filter	Waste oil	ND	Cond. organic PM	3	A	0.00068 (0.0014)		385
Wet scrubber	No. 6 fuel oil	0	Cond. organic PM	3	A	0.00090 (0.0018)		77
Dual wet scrubbers	Natural gas	30	Cond. organic PM	3	A	0.00091 (0.0018)		76
Fabric filter	ND	10	Cond. organic PM	3	C	0.0011 (0.0021)		325
Wet scrubber	No. 2 fuel oil	0	Cond. organic PM	3	A	0.0011 (0.0023)		52
Venturi scrubber	Natural gas	0	Cond. organic PM	3	A	0.0014 (0.0029)		145

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0019 (0.0039)		97
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0020 (0.0039)		72
Fabric filter	No. 6 fuel oil	26	Cond. organic PM	3	A	0.0022 (0.0045)		79
Venturi scrubber	Propane	0	Cond. organic PM	3	A	0.0026 (0.0051)		69
Wet scrubber	Natural gas	35,26	Cond. organic PM	3,3	A	0.0032 (0.0064)		61,62
Fabric filter	No. 6 fuel oil	15	Cond. organic PM	3	A	0.0034 (0.0067)		83
Fabric filter	Natural gas	0	Cond. organic PM	3	A	0.0040 (0.0081)		86
Fabric filter	No. 2 fuel oil	ND	Cond. organic PM	3	A	0.0040 (0.0080)		170
Fabric filter	Natural gas	0	Cond. organic PM	2	B	0.0045 (0.0090)		47
Wet scrubber	No. 6 fuel oil	0	Cond. organic PM	3	A	0.0046 (0.0091)		80
Fabric filter	No. 6 fuel oil	30	Cond. organic PM	3	A	0.0091 (0.018)		49
~~Fabric filter~~	~~Propane~~	~~ND~~	~~Cond. PM~~	~~3~~	~~A~~	~~0.0038 (0.0076)~~		~~240~~
~~Fabric filter~~	~~Natural gas~~	~~0~~	~~Cond. PM~~	~~3~~	~~B~~	~~0.00036 (0.00071)~~		~~46~~
None	No. 2 fuel oil	0	Filterable PM	ND	D	14 (27)	16 (32), E	5
None	No. 2 fuel oil	0	Filterable PM	ND	D	18 (37)		5
Fabric filter	ND	ND	Filterable PM	3	C	0.0012 (0.0023)	0.013 (0.025), A	331
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	A	0.0012 (0.0024)		143
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0013 (0.0026)		193
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0014 (0.0029)		253
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0014 (0.0027)		181
Fabric filter	ND	0	Filterable PM	3	B	0.0014 (0.0028)		41
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0016 (0.0031)		249
Fabric filter	Propane	0	Filterable PM	3	A	0.0016 (0.0033)		327
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0017 (0.0034)		46

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	ND	0	Filterable PM	3	C	0.0017 (0.0034)		256
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0018 (0.0037)		47
Fabric filter	No. 6 fuel oil	15	Filterable PM	3	A	0.0019 (0.0039)		83
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0023 (0.0046)		274
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0024 (0.0047)		195
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0026 (0.0053)		24
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	C	0.0026 (0.0053)		40
Fabric filter	Waste oil	0	Filterable PM	3	C	0.0027 (0.0054)		40
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0028 (0.0055)		318
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.0028 (0.0057)		188
Fabric filter	Coal/ natural gas	0	Filterable PM	2	B	0.0029 (0.0057)		336
Fabric filter	No. 2 fuel oil	ND	Filterable PM	2	B	0.0030 (0.0060)		304
Fabric filter	ND	0	Filterable PM	3	C	0.0032 (0.0064)		202
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0032 (0.0064)		176
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0033 (0.0065)		110
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0034 (0.0068)		72
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0035 (0.0070)		271
Fabric filter	No. 6 fuel oil	26	Filterable PM	3	A	0.0038 (0.0076)		79
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.0038 (0.0076)		135
Fabric filter	Propane	0	Filterable PM	3	A	0.0039 (0.0079)		225
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0040 (0.0080)		248
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0043 (0.0086)		204
Fabric filter	Propane	ND	Filterable PM	3	A	0.0043 (0.0086)		220
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0044 (0.0088)		113

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0044 (0.0088)		224
Fabric filter	Natural gas	20	Filterable PM	3	A	0.0045 (0.0090)		382
Fabric filter	Reprocessed No. 4 fuel oil	0	Filterable PM	3	A	0.0045 (0.0091)		265
Fabric filter	Natural gas	ND	Filterable PM	1	C	0.0047 (0.0093)		239
Fabric filter	Propane	ND	Filterable PM	3	A	0.0049 (0.0097)		240
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	B	0.0050 (0.010)		261
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0051 (0.010)		281
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0053 (0.011)		320
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0054 (0.011)		317
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0054 (0.011)		203
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0059 (0.012)		86
Fabric filter	Propane	ND	Filterable PM	3	A	0.0060 (0.012)		263
Fabric filter	Natural gas	0	Filterable PM	2	B	0.0062 (0.012)		276
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.0062 (0.013)		323
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0064 (0.013)		328
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0068 (0.014)		264
Fabric filter	Propane	0	Filterable PM	3	A	0.0070 (0.014)		199
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.0072 (0.014)		138
Fabric filter	Natural gas	10	Filterable PM	3	A	0.0075 (0.015)		313
Fabric filter	Coal/ liquid propane	0	Filterable PM	3	A	0.0080 (0.016)		219
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	A	0.0080 (0.016)		319
Fabric filter	Natural gas	0	Filterable PM	3	A	0.0082 (0.016)		97
Fabric filter	Waste oil	0	Filterable PM	3	A	0.0084 (0.017)		321

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0085 (0.017)		282
Fabric filter	No. 4 fuel oil	0	Filterable PM	3	B	0.0086 (0.017)		275
Fabric filter	Natural gas	10	Filterable PM	3	A	0.0091 (0.018)		308
Fabric filter	Natural gas	ND	Filterable PM	3	A	0.0094 (0.019)		326
Fabric filter	Propane	ND	Filterable PM	2	B	0.011 (0.022)		165
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.011 (0.021)		312
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.011 (0.021)		314
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.014 (0.027)		170
Fabric filter	ND	10	Filterable PM	3	C	0.014 (0.028)		325
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.015 (0.029)		296
Fabric filter	ND	0	Filterable PM	2	C	0.015 (0.029)		100
Fabric filter	Natural gas	ND	Filterable PM	3	B	0.016 (0.033)		213
Fabric filter	Coal/propane	0	Filterable PM	3	A	0.016 (0.032)		98
Fabric filter	Natural gas	22	Filterable PM	1	C	0.018 (0.036)		222
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	B	0.018 (0.036)		15
Fabric filter	ND	0	Filterable PM	3	C	0.019 (0.037)		40
Fabric filter	Natural gas	0	Filterable PM	3	A	0.022 (0.044)		284
Fabric filter	Coal/propane	0	Filterable PM	3	A	0.023 (0.046)		126
Fabric filter	Natural gas	0	Filterable PM	3	B	0.023 (0.046)		283
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.024 (0.048)		302
Fabric filter	Natural gas	0	Filterable PM	2	C	0.028 (0.055)		1
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.028 (0.057)		161
Fabric filter	No. 6 fuel oil	0	Filterable PM	3	B	0.028 (0.057)		140
Fabric filter	Reprocessed oil	ND,0	Filterable PM	3,3	B,A	0.030 (0.060)		200,201

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 2 fuel oil	ND	Filterable PM	3	A	0.033 (0.065)		250
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.041 (0.082)		111
Fabric filter	No. 2 fuel	0	Filterable PM	3	A	0.042 (0.085)		184
Fabric filter	No. 6 fuel oil	30	Filterable PM	3	A	0.045 (0.089)		49
Fabric filter	Natural gas	0	Filterable PM	3	A	0.046 (0.091)		310
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.050 (0.10)		106
~~Fabric filter~~	~~Natural gas~~	~~0~~	~~Filterable PM~~	~~2~~	~~C~~	~~0.054 (0.11)~~		~~1~~
Fabric filter	No. 2 fuel oil	0	Filterable PM	3	A	0.055 (0.11)		155
~~Fabric filter~~	~~ND~~	~~0~~	~~Filterable PM~~	~~ND~~	~~C~~	~~0.067 (0.13)~~		~~1~~
~~Fabric filter~~	~~No. 2 fuel oil~~	~~0~~	~~Filterable PM~~	~~2~~	~~C~~	~~0.071 (0.14)~~		~~1~~
~~Fabric filter~~	~~ND~~	~~0~~	~~Filterable PM~~	~~3~~	~~C~~	~~0.093 (0.19)~~		~~40~~
Fabric filter	Natural gas	ND	Filterable PM	3,3,3	B	0.087 (0.17)		215-217
Fabric filter	Waste oil	ND	Filterable PM	3	A	0.088 (0.18)		385
Venturi scrubber	No. 4 waste oil	0	Filterable PM	3	C	0.014 (0.027)	0.061 (0.12), C 0.012 (0.025), NR	177
Venturi scrubber	Propane	0	Filterable PM	3	A	0.014 (0.028)		69
Wet scrubber	No. 2 fuel oil	0	Filterable PM	3	A	0.016 (0.031)		52
Scrubber	ND	0	Filterable PM	3	C	0.017 (0.034)		139
Wet cyclonic scrubber	ND	0	Filterable PM	3	B	0.020 (0.041)		15
Venturi scrubber	No. 2 fuel oil	0	Filterable PM	2	C	0.026 (0.052)		15
Wet cyclone	Natural gas	0	Filterable PM	3	B	0.035 (0.069)		15
Venturi scrubber	ND	ND	Filterable PM	3	C	0.049 (0.098)		291
Venturi scrubber	ND	ND	Filterable PM	3	C	0.052 (0.10)		290
Venturi scrubber	Natural gas	ND	Filterable PM	1	C	0.059 (0.12)		307
Low-energy scrubber	Natural gas	0	Filterable PM	3	B	0.061 (0.12)		15

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Wet scrubber	Natural gas	0	Filterable PM	2	C	0.061 (0.12)		15
Wet scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.078 (0.16)		77
Wet scrubber	Natural gas, waste oil	26,35	Filterable PM	3,3	A	0.10 (0.20)		62,61
Wet scrubber	No. 6 fuel oil	0	Filterable PM	3	A	0.17 (0.34)		80
Venturi scrubber	Natural gas	0	Filterable PM	3	A	0.20 (0.40)		145
~~Dual wet scrubbers~~	~~Natural gas~~	~~30~~	~~Filterable PM~~	~~3~~	~~A~~	~~0.012 (0.025)~~		~~76~~
~~Centrifugal scrubber~~	~~ND~~	~~0~~	~~Filterable PM~~	~~ND~~	~~C~~	~~0.14 (0.28)~~		~~1~~
~~Spray tower~~	~~ND~~	~~0~~	~~Filterable PM~~	~~ND~~	~~C~~	~~0.32 (0.65)~~		~~1~~
None	No. 2 fuel oil	0	Filterable PM-10	ND	D	2.9 (5.9)	3.5 (6.9), NR	5
None	No. 2 fuel oil	0	Filterable PM-10	ND	D	3.9 (7.8)		5
None	ND	0	Filterable PM-15	ND	D	23% of filt. PM	23% of filt. PM, 3.7 (7.4), E	23
None	ND	0	Filterable PM-10	ND	D	14% of filt. PM	14% of filt. PM, 2.2 (4.5), E	23
None	ND	0	Filterable PM-5	ND	D	3.5% of filt. PM	3.5% of filt. PM, 0.56 (1.1), E	23
None	ND	0	Filterable PM-2.5	ND	D	0.83% of filt. PM	0.83% of filt. PM, 0.13 (0.27), E	23
Fabric filter	ND	0	Filterable PM-15	1	C	47% of filt. PM	47% of filt. PM, 0.0059 (0.012), E	23[c]
Fabric filter	Natural gas	0	Filterable PM-10	3	C	0.0010 (0.0020) 37.7% of filt. PM	39% of filt. PM, 0.0049 (0.0098), E	24
Fabric filter	ND	0	Filterable PM-10	1	C	40% of filt. PM		23[c]
Fabric filter	ND	0	Filterable PM-5	1	C	36% of filt. PM	36% of filt. PM, 0.0045 (0.0090), E	23[c]

Table 4-19 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	ND	0	Filterable PM-2.5	1	C	33% of filt. PM	33% of filt. PM, 0.0041 (0.0083), E	23[c]
Fabric filter	ND	0	Filterable PM-1	1	C	30% of filt. PM	30% of filt. PM, 0.0038 (0.0075), E	23[c]
~~Multiple wet scrubbers~~	~~ND~~	~~0~~	~~Total PM~~	~~2~~	~~C~~	~~0.0045 (0.0090)~~		~~15~~
~~Multiple wet scrubbers~~	~~ND~~	~~0~~	~~Total PM~~	~~2~~	~~C~~	~~0.045 (0.089)~~		~~15~~
~~Wet scrubber~~	~~ND~~	~~0~~	~~Total PM~~	~~3~~	~~C~~	~~0.37 (0.75)~~		~~40~~
~~Wet scrubber~~	~~No. 2 fuel oil~~	~~0~~	~~Total PM~~	~~3~~	~~C~~	~~0.029 (0.058)~~		~~40~~
~~Wet scrubber~~	~~No. 2 fuel oil~~	~~0~~	~~Total PM~~	~~3~~	~~C~~	~~0.21 (0.43)~~		~~40~~
~~Fabric filter~~	~~Waste oil~~	~~0~~	~~Total PM~~	~~3~~	~~C~~	~~0.039 (0.078)~~		~~40~~
~~Fabric filter~~	~~Waste oil~~	~~30~~	~~Total PM~~	~~3~~	~~C~~	~~0.061 (0.12)~~		~~40~~

ND = No data available, NR = not rated

[a]Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b]Emission factors developed from data collected during a plant survey.

[c]Secondary data from Reference 26 within Reference 23.

Table 4-20. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR CO, CO_2, METHANE, NO_x, O_3, SO_2, AND TOC; BATCH MIX FACILITY – DRYERS

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	0	CO	3	A	0.017 (0.033)	0.20 (0.40), C	46
Fabric filter	Natural gas	15	CO	3	A	0.019 (0.039)		370
Fabric filter	Natural gas	15	CO	3	A	0.052 (0.10)		381
Fabric filter	Natural gas	0	CO	3	B	0.055 (0.11)		34
Fabric filter	Natural gas	15	CO	3	A	0.056 (0.11)		378
Fabric filter	Natural gas	0	CO	8	A	0.095 (0.19)		47
Fabric filter	Natural gas	ND	CO	3	A	0.13 (0.25)		282
~~Fabric filter~~	~~Natural gas~~	~~ND~~	~~CO~~	~~3~~	~~D~~	~~0.40 (0.80)~~		~~296~~
Fabric filter	Natural gas	ND	CO	3,3,3	C,B,B	0.60 (1.2)		215-217
Fabric filter	Natural gas	0	CO	4	B	0.50 (1.0)		24
Fabric filter	No. 2 fuel oil	0	CO	3	A	0.19 (0.37)		161
Fabric filter	No. 2 fuel oil	ND	CO	3	B	0.65 (1.3)		204
Fabric filter	No. 6 fuel oil	30	CO	9	A	0.035 (0.069)		49
Fabric filter	Coal/ liquid propane	0	CO_2	3	A	6.8 (14)	18 (37), A	219
Fabric filter	Coal/ natural gas	0	CO_2	3	B	11 (21)		336
Fabric filter	Coal/propane	0	CO_2	3	A	11 (21)		98
Fabric filter	Coal/propane	0	CO_2	3	B	15 (29)		126
Fabric filter	Natural gas	22	CO_2	3	C	3.4 (6.9)		222
Fabric filter	Natural gas	0,10	CO_2	3,3	A	14 (28)		310,313
Fabric filter	Natural gas	0	CO_2	1	C	7.0 (14)		287
Fabric filter	Natural gas	0,0,ND,15	CO_2	1,1,1,1	C	13 (26)		232-235
Fabric filter	Natural gas	10	CO_2	3	A	8.2 (16)		308
Fabric filter	Natural gas	0	CO_2	2	B	8.7 (17)		276
Fabric filter	Natural gas	ND	CO_2	1	C	8.8 (18)		288
Fabric filter	Natural gas	ND	CO_2	3	A	10 (20)		203
Fabric filter	Natural gas	ND	CO_2	1	C	10 (20)		286
Fabric filter	Natural gas	0	CO_2	3	A	10 (20)		264

Table 4-20 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	0	CO_2	3	A	10 (20)		46
Low-energy scrubber[b]	Natural gas	0	CO_2	3	B	11 (22)		15
Fabric filter	Natural gas	ND	CO_2	1	C	11 (22)		289
Fabric filter	Natural gas	15	CO_2	3	A	12 (23)		370
Fabric filter	Natural gas	ND	CO_2	1	B	12 (24)		278
Dual wet scrubbers	Natural gas	30	CO_2	3	A	12 (23)		76
Fabric filter	Natural gas	0	CO_2	1	C	12 (24)		285
Wet scrubber [c]	Natural gas	0	CO_2	2	C	12 (24)		15
Fabric filter	Natural gas	0,ND,ND	CO_2	3	C	13 (25)		231,237,238
Fabric filter	Natural gas	ND	CO_2	3	A	14 (27)		282
Fabric filter	Natural gas	ND	CO_2	3	A	14 (28)		328
Fabric filter	Natural gas	15	CO_2	3	A	15 (29)		381
Wet cyclone	Natural gas	0	CO_2	3	B	15 (31)		15
Fabric filter	Natural gas	0	CO_2	3	A	15 (31)		72
Fabric filter	Natural gas	20	CO_2	3	A	16 (31)		382
Fabric filter	Natural gas	15	CO_2	3	A	17 (33)		378
Fabric filter	Natural gas	ND	CO_2	9	B	17 (34)		215-217
Fabric filter	Waste oil	ND	CO_2	3	A	17 (35)		385
Fabric filter	Natural gas	0	CO_2	3	A	15 (29)		284
Fabric filter	Natural gas	ND	CO_2	1	B	16 (32)		277
Fabric filter	Natural gas	ND	CO_2	3	B	16 (32)		135
Wet scrubber	Natural gas	35,26	CO_2	6	A	17 (33)		61, 62
Fabric filter	Natural gas	0	CO_2	3	B	17 (33)		283
Fabric filter	Natural gas	15	CO_2	3	A	17 (33)		378
Fabric filter	Natural gas	ND	CO_2	1	B	17 (34)		279
Fabric filter	Natural gas	0	CO_2	3	A	18 (36)		176
Fabric filter	Natural gas	0	CO_2	3	B	19 (38)		86

Table 4-20 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	ND	CO_2	3	C	19 (37)		239
Fabric filter	Natural gas	ND	CO_2	3	B	20 (41)		213
Venturi scrubber	Natural gas	0	CO_2	3	B	20 (41)		145
Fabric filter	Natural gas	0	CO_2	8	A	21 (43)		47
Fabric filter	Natural gas	ND	CO_2	3	A	24 (47)		326
Fabric filter	Natural gas	ND	CO_2	3	B	26 (51)		296
Fabric filter	Natural gas	0	CO_2	12	A	28 (55)		24
Venturi scrubber	Natural gas	0,ND	CO_2	1,1	C	48 (96)		306,307
Fabric filter	Natural gas	0	CO_2	3	B	53 (110)		97
Fabric filter	Natural gas	0	CO_2	3	A	78 (160)		224
Fabric filter	ND	0	CO_2	3	C	5.0 (10)		256
Fabric filter	ND	10	CO_2	3	C	9.0 (18)		325
Fabric filter	ND	0	CO_2	2	C	14 (28)		100
Multiple wet scrubbers [d]	ND	0	CO_2	2	C	14 (28)		15
Fabric filter	ND	0	CO_2	3	B	15 (31)		41
Fabric filter	ND	ND	CO_2	3	C	15 (31)		331
Scrubber	ND	0	CO_2	3	C	29 (58)		139
Venturi scrubber	ND	ND	CO_2	3	C	30 (59)		291
Venturi scrubber	ND	ND	CO_2	3	C	49 (98)		290
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	12 (24)		193
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	6.6 (13)		312
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	8.8 (18)		113
Fabric filter [e]	No. 2 fuel oil	0	CO_2	3	B	9.4 (19)		15
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	10 (20)		111
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	12 (24)		195
Wet scrubber	No. 2 fuel oil	0	CO_2	3	A	12 (24)		52
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	12 (24)		274
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	14 (28)		155

Table 4-20 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	14 (27)		253
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	15 (30)		261
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	16 (32)		110
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	16 (31)		181
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	16 (32)		170
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	16 (31)		248
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	17 (34)		188
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	17 (33)		226
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	17 (34)		314
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	18 (37)		204
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	19 (38)		250
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	19 (37)		302
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	20 (40)		249
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	21 (42)		271
Fabric filter	No. 2 fuel oil	ND	CO_2	3	A	25 (50)		323
Fabric filter	No. 2 fuel oil	ND	CO_2	3	B	25 (50)		304
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	28 (55)		184
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	32 (64)		281
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	34 (69)		138
Fabric filter	No. 2 fuel oil	0	CO_2	3	A	45 (91)		106
Fabric filter	No. 2 fuel oil	0	CO_2	3	B	47 (93)		161
Venturi scrubber	No. 4 waste oil	0	CO_2	3	C	10 (20)		177
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	14 (27)		317
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	16 (31)		318
Fabric filter	No. 4 fuel oil	0	CO_2	3	A	17 (34)		319
Fabric filter	No. 4 fuel oil	0	CO_2	3	B	19 (38)		275
Fabric filter	No. 6 fuel oil	15	CO_2	3	A	18 (36)		83
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	19 (37)		140
Wet scrubber	No. 6 fuel oil	0	CO_2	3	A	19 (39)		77

Table 4-20 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	No. 6 fuel oil	0	CO_2	3	B	19 (37)		143
Fabric filter	No. 6 fuel oil	26	CO_2	3	A	20 (40)		79
Wet scrubber	No. 6 fuel oil	0	CO_2	3	A	23 (46)		80
Fabric filter	No. 6 fuel oil	30	CO_2	9	A	29 (59)		49
Venturi scrubber	Propane	0	CO_2	3	A	11 (23)		69
Fabric filter	Propane	ND	CO_2	3	A	14 (27)		263
Fabric filter	Propane	0	CO_2	3	A	15 (30)		199
Fabric filter	Propane	ND	CO_2	3	A	17 (34)		240
Fabric filter	Propane	ND	CO_2	3	A	19 (39)		220
Fabric filter	Propane	ND	CO_2	2	B	25 (50)		165
Fabric filter	Propane	0	CO_2	3	A	28 (55)		327
Fabric filter	Propane	0	CO_2	3	A	53 (110)		225
Fabric filter	Reprocessed No. 4 fuel oil	0	CO_2	3	A	15 (30)		265
Fabric filter	Reprocessed oil	0	CO_2	3	A	19 (38)		201
Fabric filter	Reprocessed oil	ND,0	CO_2	3,3	B,C	18 (36)		200,202
Fabric filter	Waste oil	0	CO_2	3	A	15 (31)		321
Fabric filter	Waste oil	0	CO_2	3	A	19 (37)		320
Fabric filter	Natural gas	0	Methane	2	B	0.00058 (0.0012)	0.0037 (0.0074), D	46
Fabric filter	Natural gas	0	Methane	8	A	0.0099 (0.020)		47
Fabric filter	No. 6 fuel oil	30	Methane	8	A	0.0022 (0.0043)		49
Fabric filter	Natural gas	0	Methane[f]	13	B	0.0021 (0.0042)		24
Fabric filter	Natural gas	0	NO_x	3	A	0.0071 (0.014)	0.013 (0.025), D	46
Fabric filter	Natural gas	0	NO_x	8	A	0.011 (0.022)		47
Fabric filter	Natural gas	0	NO_x	3	B	0.013 (0.026)		34
Fabric filter	Natural gas	0	NO_x	9	A	0.020 (0.039)		24
Fabric filter	No. 2 fuel oil	0	NO_x	8	A	0.031 (0.061)	0.058 (0.12), E	226
Fabric filter	No. 6 fuel oil	30	NO_x	9	A	0.084 (0.17)		49
Fabric filter	No. 2 fuel oil	0	O_3	8	D	8.4×10^{-5} (0.00017)	8.4×10^{-5} (0.00017), NR	226

Table 4-20 (cont.)

Type of control	Fuel fired	Percent RAP used	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Coal/propane	0	SO_2	3	A	0.022 (0.043)	0.022 (0.043), E	126
~~Fabric filter~~	~~Coal/propane~~	~~0~~	~~SO_2~~	~~3~~	~~D~~	~~0.027 (0.053)~~		~~98~~
Fabric filter	Natural gas	0	SO_2	8	A	0.0017 (0.0034)	0.0023 (0.0046), E	47
Fabric filter	Natural gas	0	SO_2	3	A	0.0029 (0.0057)		46
Fabric filter	Waste oil	ND	SO_2	3	A	0.0013 (0.0027)	0.044 (0.088), E	385
Fabric filter	No. 2 fuel oil	0	SO_2	8	A	0.011 (0.021)		226
Fabric filter	No. 6 fuel oil	30	SO_2	9	A	0.12 (0.24)		49
Fabric filter	Natural gas	0	TOC as propane	1	C	0.0044 (0.0087)	0.0073 (0.015), D	46
Fabric filter	Natural gas	0	TOC as propane	8	A	0.0095 (0.019)		47
Fabric filter	Natural gas	0	TOC as propane	9	A	0.010 (0.021)		24
Fabric filter	No. 2 fuel oil	0	TOC as propane	3	A	0.0052 (0.010)		155
~~Fabric filter~~	~~No. 2 fuel oil~~	~~0~~	~~TOC as propane~~	~~3~~	~~C~~	~~4.0 (8.0)~~		~~161~~
Fabric filter	No. 6 fuel oil	30	TOC as propane	9	A	0.021 (0.043)	0.021 (0.043), E	49

ND = No data available, NR = not rated

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. Data that are ~~crossed out~~ are not used for emission factor development.

[b] Plant EE.

[c] Plant FF.

[d] Plant AA.

[e] Plant O.

[f] Average emission factor computed using an assumed detection limit.

Table 4-21. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR METALS; BATCH MIX FACILITY – DRYERS

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	Arsenic	3	C	$1.7x10^{-7}$ ($3.3x10^{-7}$)	$2.3x10^{-7}$ ($4.6x10^{-7}$), D	34
Fabric filter	ND	Arsenic	3	C	$4.9x10^{-7}$ ($9.9x10^{-7}$)		40
Fabric filter	No. 2 fuel oil	Arsenic	3	A	$3.3x10^{-8}$ ($6.7x10^{-8}$)		226
Fabric filter	Natural gas	Barium	2	B	$7.3x10^{-7}$ ($1.5x10^{-6}$)	$7.3x10^{-7}$ ($1.5x10^{-6}$), E	24
Fabric filter	Natural gas	Beryllium	3	C	$1.1x10^{-7}$ ($2.2x10^{-7}$)	$7.4x10^{-8}$ ($1.5x10^{-7}$), E	34
Fabric filter	No. 2 fuel oil	Beryllium	3	A	$3.8x10^{-8}$ ($7.5x10^{-8}$)		226
Fabric filter	Natural gas	Cadmium	3	B	$6.5x10^{-7}$ ($1.3x10^{-6}$)	$3.0x10^{-7}$ ($6.1x10^{-7}$), D	34
Fabric filter	Natural gas	Cadmium	2	B	$1.9x10^{-7}$ ($3.8x10^{-7}$)		24
Fabric filter	No. 2 fuel oil	Cadmium	6	A	$7.2x10^{-8}$ ($1.4x10^{-7}$)		226
Fabric filter	Natural gas	Chromium	3	C	$1.5x10^{-7}$ ($3.0x10^{-7}$)	$2.9x10^{-7}$ ($5.7x10^{-7}$), D	34
Fabric filter	Natural gas	Chromium	2	B	$4.5x10^{-7}$ ($8.9x10^{-7}$)		24
Fabric filter	No. 2 fuel oil	Chromium	3	A	$2.6x10^{-7}$ ($5.2x10^{-7}$)		226
Fabric filter	Natural gas	Copper	2	B	$9.9x10^{-7}$ ($2.0x10^{-6}$)	$1.4x10^{-6}$ ($2.8x10^{-6}$), D	24
Fabric filter	Natural gas	Copper	3	B	$2.7x10^{-6}$ ($5.3x10^{-6}$)		34
Fabric filter	No. 2 fuel oil	Copper	3	A	$5.6x10^{-7}$ ($1.1x10^{-6}$)		226
Fabric filter	Natural gas	Hexavalent chromium	3	C	$4.9x10^{-9}$ ($9.7x10^{-9}$)	$2.4x10^{-8}$ ($4.8x10^{-8}$), E	34
Fabric filter	No. 2 fuel oil	Hexavalent chromium	3	A	$4.3x10^{-8}$ ($8.6x10^{-8}$)		226
Fabric filter	Natural gas	Lead	3	B	$1.9x10^{-7}$ ($3.7x10^{-7}$)	$4.5x10^{-7}$ ($8.9x10^{-7}$), D	34
Fabric filter	Natural gas	Lead	2	B	$5.3x10^{-7}$ ($1.1x10^{-6}$)		24
Fabric filter	No. 2 fuel oil	Lead	3	A	$5.7x10^{-7}$ ($1.2x10^{-6}$)		226
~~Fabric filter~~	~~No. 4 fuel oil~~	~~Lead~~	~~3~~	C[b]	~~$1.9x10^{-6}$ ($3.7x10^{-6}$)~~		~~317~~
~~Fabric filter~~	~~No. 4 fuel oil~~	~~Lead~~	~~3~~	C[b]	~~$1.9x10^{-6}$ ($3.8x10^{-6}$)~~		~~319~~
~~Fabric filter~~	~~No. 4 fuel oil~~	~~Lead~~	~~3~~	C[b]	~~$1.7x10^{-6}$ ($3.5x10^{-6}$)~~		~~318~~
Venturi scrubber	Waste oil, No. 4	Lead	3	C	$3.1x10^{-6}$ ($6.2x10^{-6}$)	$5.1x10^{-6}$ ($1.0x10^{-5}$), E	177
Fabric filter	Waste oil	Lead	3	A	$7.0x10^{-6}$ ($1.4x10^{-5}$)		321
Fabric filter	Natural gas	Manganese	3	B	$2.9x10^{-6}$ ($5.8x10^{-6}$)	$3.5x10^{-6}$ ($6.9x10^{-6}$), D	34

Table 4-21 (cont.)

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. No.
Fabric filter	Natural gas	Manganese	2	B	7.1×10^{-6} (1.4×10^{-5})		24
Fabric filter	No. 2 fuel oil	Manganese	3	A	4.6×10^{-7} (9.2×10^{-7})		226
Fabric filter	Natural gas	Mercury	3	B	2.3×10^{-7} (4.5×10^{-7})	2.0×10^{-7} (4.1×10^{-7}), E	34
Fabric filter	No. 2 fuel oil	Mercury	3	A	1.8×10^{-7} (3.6×10^{-7})		226
Fabric filter	Natural gas	Nickel	3	B	1.0×10^{-6} (2.0×10^{-6})	1.5×10^{-6} (3.0×10^{-6}), D	34
Fabric filter	Natural gas	Nickel	2	B	3.2×10^{-6} (6.4×10^{-6})		24
Fabric filter	No. 2 fuel oil	Nickel	3	A	2.7×10^{-7} (5.4×10^{-7})		226
Fabric filter	Natural gas	Selenium	3	C	4.6×10^{-8} (9.2×10^{-8})	2.4×10^{-7} (4.9×10^{-7}), E	34
Fabric filter	No. 2 fuel oil	Selenium	3	A	4.4×10^{-7} (8.8×10^{-7})		226
Fabric filter	Natural gas	Zinc	2	B	3.2×10^{-6} (6.3×10^{-6})	3.4×10^{-6} (6.8×10^{-6}), D	24
Fabric filter	Natural gas	Zinc	3	B	3.7×10^{-6} (7.3×10^{-6})		34
Fabric filter	No. 2 fuel oil	Zinc	3	A	3.4×10^{-6} (6.8×10^{-6})		226

ND = No data available, NR = not rated, NA = not applicable

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. RAP was not processed during any of the tests. Data that are ~~crossed out~~ are not used for emission factor development.

[b] These C-rated data are not included in the candidate emission factor because they are based on one-half of the detection limit for non-detect runs; the factors based on one-half of the detection limit are higher than factors based on actual measurements made during other tests.

Table 4-22. SUMMARY OF EMISSION FACTOR DEVELOPMENT FOR ORGANIC COMPOUNDS; BATCH MIX FACILITY – DRYERS

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. N.
Fabric filter	Natural gas	2-Methylnaphthalene	3	A	5.8x10^{-5} (0.00012)	3.6x10^{-5} (7.1x10^{-5}), D	24
Fabric filter	Natural gas	2-Methylnaphthalene	3	A	1.6x10^{-5} (3.3x10^{-5})		47
Fabric filter [b]	No. 6 fuel oil	2-Methylnaphthalene	3	A	3.0x10^{-5} (6.0x10^{-5})		49
Fabric filter	Natural gas	Acenaphthene	3	A	1.0x10^{-6} (2.1x10^{-6})	4.5x10^{-7} (9.0x10^{-7}), D	46
Fabric filter	Natural gas	Acenaphthene	3	B	2.9x10^{-7} (5.7x10^{-7})		34
Fabric filter	No. 2 fuel oil	Acenaphthene	3	A	1.0x10^{-8} (2.1x10^{-8})		226
Fabric filter	Natural gas	Acenaphthylene	3	B	1.6x10^{-7} (3.2x10^{-7})	2.9x10^{-7} (5.8x10^{-7}), D	34
Fabric filter	Natural gas	Acenaphthylene	3	A	7.0x10^{-7} (1.4x10^{-6})		46
Fabric filter	No. 2 fuel oil	Acenaphthylene	3	A	1.0x10^{-8} (2.0x10^{-8})		226
Fabric filter [c]	Natural gas	Acetaldehyde	3	A	0.00032 (0.00064)	0.00016 (0.00032), E	24
Fabric filter [c]	Natural gas	Acetaldehyde	2	C	6.0x10^{-7} (1.2x10^{-6})		34
Fabric filter [c]	Natural gas	Acetone	2	D	0.0032 (0.0064)	0.0032 (0.0064), NR	24
Fabric filter	Natural gas	Anthracene	3	A	2.7x10^{-7} (5.3x10^{-7})	1.1x10^{-7} (2.1x10^{-7}), D	46
Fabric filter	Natural gas	Anthracene	3	B	4.4x10^{-8} (8.8x10^{-8})		34
Fabric filter	No. 2 fuel oil	Anthracene	3	A	8.3x10^{-9} (1.7x10^{-8})		226
Fabric filter [c]	Natural gas	Benzaldehyde	3	A	6.4x10^{-5} (0.00013)	6.4x10^{-5} (0.00013), E	24
Fabric filter [c]	Natural gas	Benzene	3	C	3.5x10^{-5} (7.0x10^{-5})	0.00014 (0.00028), D	34
Fabric filter [c]	Natural gas	Benzene[d]	13	B	0.000096 (0.00019)		24
Fabric filter [c]	Natural gas	Benzene[d]	20	A	0.00018 (0.00036)		382
Fabric filter [c]	Natural gas	Benzene	3	A	0.00025 (0.00050)		46
~~Fabric filter [c]~~	~~Natural gas~~	~~Benzene~~	~~3~~	~~C[e]~~	~~0.00026 (0.00052)~~		~~47~~
~~Fabric filter [c]~~	~~No. 6 fuel oil~~	~~Benzene~~	~~3~~	~~C[e]~~	~~0.00057 (0.0011)~~		~~49~~
Fabric filter	Natural gas	Benzo(a)anthracene	3	A	1.4x10^{-9} (2.8x10^{-9})	2.3x10^{-9} (4.6x10^{-9}), E	46
Fabric filter	No. 2 fuel oil	Benzo(a)anthracene	3	A	3.2x10^{-9} (6.3x10^{-9})		226
Fabric filter	No. 2 fuel oil	Benzo(a)pyrene	3	A	1.6x10^{-10} (3.1x10^{-10})	1.6x10^{-10} (3.1x10^{-10}), E	226

Table 4-22 (cont.)

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. N.
Fabric filter	Natural gas	Benzo(b)fluoranthene	3	C	$1.1x10^{-8}$ ($2.2x10^{-8}$)	$4.7x10^{-9}$ ($9.4x10^{-9}$), D	34
Fabric filter	Natural gas	Benzo(b)fluoranthene	3	A	$8.8x10^{-10}$ ($1.8x10^{-9}$)		46
Fabric filter	No. 2 fuel oil	Benzo(b)fluoranthene	3	A	$2.2x10^{-9}$ ($4.5x10^{-9}$)		226
Fabric filter	No. 2 fuel oil	Benzo(g,h,i)perylene	3	A	$2.5x10^{-10}$ ($5.0x10^{-10}$)	$2.5x10^{-10}$ ($5.0x10^{-10}$), E	226
Fabric filter	Natural gas	Benzo(k)fluoranthene	3	C	$1.2x10^{-8}$ ($2.4x10^{-8}$)	$6.3x10^{-9}$ ($1.3x10^{-8}$), E	34
Fabric filter	No. 2 fuel oil	Benzo(k)fluoranthene	3	A	$5.6x10^{-10}$ ($1.1x10^{-9}$)		226
Fabric filter [c]	Natural gas	Butyraldehyde/Isobutyraldehyde	3	A	$1.5x10^{-5}$ ($3.0x10^{-5}$)	$1.5x10^{-5}$ ($3.0x10^{-5}$), E	24
Fabric filter	Natural gas	Chrysene	3	A	$3.1x10^{-9}$ ($6.3x10^{-9}$)	$1.9x10^{-9}$ ($3.8x10^{-9}$), E	46
Fabric filter	No. 2 fuel oil	Chrysene	3	A	$6.1x10^{-10}$ ($1.2x10^{-9}$)		226
Fabric filter [c]	Natural gas	Crotonaldehyde	3	A	$1.5x10^{-5}$ ($2.9x10^{-5}$)	$1.5x10^{-5}$ ($2.9x10^{-5}$), E	24
Fabric filter	No. 2 fuel oil	Dibenz(a,h)anthracene	3	A	$4.8x10^{-11}$ ($9.5x10^{-11}$)	$4.8x10^{-11}$ ($9.5x10^{-11}$), E	226
Fabric filter [c]	Natural gas	Ethylbenzene	3	C	0.00035 (0.00070)	0.0011 (0.0022), D	47
Fabric filter [c]	Natural gas	Ethylbenzene	3	A	0.00042 (0.00083)		46
Fabric filter [c]	No. 6 fuel oil	Ethylbenzene	3	C	0.00078 (0.0016)		49
Fabric filter [c]	Natural gas	Ethylbenzene[d]	13	B	0.0028 (0.0057)		24
Fabric filter	Natural gas	Fluoranthene	3	A	$2.1x10^{-7}$ ($4.1x10^{-7}$)	$8.1x10^{-8}$ ($1.6x10^{-7}$), D	47
Fabric filter	Natural gas	Fluoranthene	3	B	$2.2x10^{-8}$ ($4.4x10^{-8}$)		34
Fabric filter	Natural gas	Fluoranthene	3	A	$5.3x10^{-8}$ ($1.1x10^{-7}$)		46
Fabric filter	No. 2 fuel oil	Fluoranthene	3	A	$4.4x10^{-8}$ ($8.7x10^{-8}$)		226
Fabric filter [b]	No. 6 fuel oil	Fluoranthene	3	A	$1.2x10^{-5}$ ($2.4x10^{-5}$)	$1.2x10^{-5}$ ($2.4x10^{-5}$), E	49
Fabric filter	Natural gas	Fluorene	3	A	$1.9x10^{-6}$ ($3.8x10^{-6}$)	$8.2x10^{-7}$ ($1.6x10^{-6}$), D	46
Fabric filter	Natural gas	Fluorene	3	B	$3.3x10^{-7}$ ($6.5x10^{-7}$)		34
Fabric filter	Natural gas	Fluorene	3	A	$8.8x10^{-7}$ ($1.8x10^{-6}$)		47
Fabric filter	No. 2 fuel oil	Fluorene	3	A	$1.4x10^{-7}$ ($2.7x10^{-7}$)		226
Fabric filter [c]	Natural gas	Formaldehyde	3	A	0.00017 (0.00035)	0.00036 (0.00074), D	46
Fabric filter [c]	Natural gas	Formaldehyde	3	A	0.00074 (0.0015)		382

Table 4-22 (cont.)

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. N.
Fabric filter [c]	Natural gas	Formaldehyde	3	A	0.0010 (0.0021)		24
Fabric filter [c]	Natural gas	Formaldehyde	3	C	$3.8x10^{-5}$ ($7.6x10^{-5}$)		34
Fabric filter [b,c]	No. 6 fuel oil	Formaldehyde	3	B	0.00040 (0.00081)		49
Fabric filter [c]	Natural gas	Formaldehyde	3	A	$6.2x10^{-5}$ (0.00012)		47
Fabric filter	No. 2 fuel oil	Formaldehyde	3	A	0.00012 (0.00024)		226
~~Wet scrubber [c]~~	~~ND~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0020 (0.0040)~~		~~40~~
~~Fabric filter [c]~~	~~ND~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0039 (0.0079)~~		~~40~~
~~Fabric filter [c]~~	~~ND~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0044 (0.0087)~~		~~40~~
~~Fabric filter [c]~~	~~No. 2 fuel oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00010 (0.00019)~~		~~40~~
~~Wet scrubber [c]~~	~~No. 2 fuel oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00053 (0.0011)~~		~~40~~
~~Wet scrubber [c]~~	~~No. 2 fuel oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0078 (0.016)~~		~~40~~
~~Fabric filter~~	~~No. 6 fuel oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.0019 (0.0038)~~		~~143~~
~~Fabric filter [c]~~	~~Waste oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00044 (0.00089)~~		~~40~~
~~Fabric filter [c]~~	~~Waste oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00088 (0.0018)~~		~~40~~
~~Fabric filter [c]~~	~~Waste oil~~	~~Formaldehyde~~	~~3~~	~~D~~	~~0.00097 (0.0019)~~		~~40~~
Fabric filter [c]	Natural gas	Hexanal	3	A	$1.2x10^{-5}$ ($2.4x10^{-5}$)	$1.2x10^{-5}$ ($2.4x10^{-5}$), E	24
Fabric filter	No. 2 fuel oil	Indeno(1,2,3-cd)pyrene	3	A	$1.5x10^{-10}$ ($3.0x10^{-10}$)	$1.5x10^{-10}$ ($3.0x10^{-10}$), E	226
Fabric filter	Natural gas	Naphthalene	3	A	$1.3x10^{-5}$ ($2.5x10^{-5}$)	$1.8x10^{-5}$ ($3.6x10^{-5}$), E	47
Fabric filter	Natural gas	Naphthalene	3	A	$4.1x10^{-5}$ ($8.1x10^{-5}$)		46
Fabric filter	Natural gas	Naphthalene	3	B	$9.5x10^{-6}$ ($1.9x10^{-5}$)		34
Fabric filter	No. 2 fuel oil	Naphthalene	3	A	$5.4x10^{-6}$ ($1.1x10^{-5}$)		226
Fabric filter [b]	No. 6 fuel oil	Naphthalene	3	A	$2.2x10^{-5}$ ($4.5x10^{-5}$)		49
Fabric filter	Natural gas	Phenanthrene	3	B	$1.0x10^{-6}$ ($2.0x10^{-6}$)	$1.3x10^{-6}$ ($2.6x10^{-6}$), D	34
Fabric filter	Natural gas	Phenanthrene	3	A	$1.1x10^{-6}$ ($2.2x10^{-6}$)		47
Fabric filter	Natural gas	Phenanthrene	3	A	$2.7x10^{-6}$ ($5.5x10^{-6}$)		46
Fabric filter	No. 2 fuel oil	Phenanthrene	3	A	$3.7x10^{-7}$ ($7.3x10^{-7}$)		226

Table 4-22 (cont.)

Type of control	Fuel fired	Pollutant	No. of test runs	Data rating	Average emission factor, kg/Mg (lb/ton)[a]	Candidate emission factor, kg/Mg (lb/ton), rating	Ref. N.
Fabric filter [b]	No. 6 fuel oil	Phenanthrene	2	B	$1.9x10^{-5}$ ($3.7x10^{-5}$)	$1.9x10^{-5}$ ($3.7x10^{-5}$), E	49
Fabric filter	Natural gas	Pyrene	3	B	$2.4x10^{-8}$ ($4.8x10^{-8}$)	$3.1x10^{-8}$ ($6.2x10^{-8}$), D	34
Fabric filter	Natural gas	Pyrene	3	A	$3.9x10^{-8}$ ($7.8x10^{-8}$)		46
Fabric filter	No. 2 fuel oil	Pyrene	3	A	$3.0x10^{-8}$ ($5.9x10^{-8}$)		226
Fabric filter [b]	No. 6 fuel oil	Pyrene	3	A	$2.7x10^{-5}$ ($5.5x10^{-5}$)	$2.7x10^{-5}$ ($5.5x10^{-5}$), E	49
Fabric filter [c]	Natural gas	Quinone	3	A	0.00014 (0.00027)	0.00014 (0.00027), E	24
Fabric filter [c]	Natural gas	Toluene	3	C	$3.7x10^{-5}$ ($7.3x10^{-5}$)	0.00052 (0.0010), D	34
Fabric filter [c]	Natural gas	Toluene	3	C	0.00030 (0.00061)		47
~~Fabric filter [c]~~	~~No. 6 fuel oil~~	~~Toluene~~	~~3~~	~~C[e]~~	~~0.00068 (0.0014)~~		~~49~~
Fabric filter [c]	Natural gas	Toluene	3	A	0.00076 (0.0015)		46
Fabric filter [c]	Natural gas	Toluene[d]	13	B	0.00099 (0.0020)		24
Fabric filter [c]	Natural gas	Xylene	3	C	0.00035 (0.00070)	0.0014 (0.0027), D	47
Fabric filter [c]	No. 6 fuel oil	Xylene	3	C	0.00078 (0.0016)		49
Fabric filter [c]	Natural gas	Xylene	3	A	0.00079 (0.0016)		46
Fabric filter [c]	Natural gas	Xylene[d]	13	B	0.0035 (0.0069)		24

[a] Emission factors in kg/Mg (lb/ton) of hot mix asphalt produced. ND = No data available. Data that are ~~crossed out~~ are not used for emission factor development.
[b] Feed included 30 percent RAP.
[c] Control device may provide only incidental control.
[d] Average emission factor computed using an assumed detection limit.
[e] These C-rated data are not included in the candidate emission factor because they are based on one-half of the detection limit for non-detect runs; the factors based on one-half of the detection limit are higher than the candidate emission factor based on actual measurements made during other tests.

Table 4-23. SUMMARY OF T-TESTS PERFORMED ON BATCH MIX DATA[a]

Sample No. 1				Sample No. 2					
Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
FILTERABLE PM									
FF, waste oil-fired, RAP <0.1	8	0.021	0.024	FF, non waste oil-fired, RAP <0.1	16	0.028	0.032	0.59	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP <0.1
VS, waste oil-fired, RAP <0.1	3	0.17	0.16	VS, non waste oil-fired, RAP <0.1	2	0.042	0.015	0.34	No difference between waste oil-fired and nonwaste oil-fired for VS and RAP <0.1
FF, oil-fired, RAP <0.1	24	0.025	0.029	FF, gas-fired, RAP <0.1	17	0.016	0.016	0.25	No difference between oil-fired and gas-fired for FF and RAP <0.1
VS, oil-fired, RAP <0.1	5	0.12	0.13	VS, gas-fired	2	0.21	0.26	0.53	No difference between oil-fired and gas-fired for VS and RAP <0.1
FF, RAP <0.1	46	0.020	0.024	VS, RAP <0.1	7	0.15	0.16	0.078	Differentiate between control devices for RAP <0.1
VS, RAP <0.1	5	0.11	0.16	WS, RAP <0.1	2	0.25	0.13	0.34	No difference between VS and WS for RAP <0.1
CONDENSABLE INORGANIC PM									
FF, waste oil-fired	3	0.0093	0.015	FF, non waste oil-fired	8	0.012	0.022	0.87	No difference between waste oil-fired and nonwaste oil-fired for FF
FF, oil-fired, RAP <0.1	4	0.0029	0.0014	FF, gas-fired, RAP <0.1	9	0.0048	0.0043	0.42	No difference between oil-fired and gas-fired for FF and RAP <0.1
FF, RAP <0.1	13	0.0042	0.0037	VS, RAP <0.1	3	0.0067	0.0083	0.38	No difference between FF and VS for RAP <0.1
CONDENSABLE ORGANIC PM									
FF, waste oil-fired	4	0.0077	0.0075	FF, non waste oil-fired	3	0.0027	0.0046	0.36	No difference between waste oil-fired and nonwaste oil-fired for FF
FF, oil-fired	7	0.0055	0.0065	FF, gas-fired	8	0.0036	0.0033	0.48	No difference between oil-fired and gas-fired for FF
VS, oil-fired, RAP <0.1	3	0.0040	0.0045	VS, gas-fired, RAP <0.1	2	0.0040	0.0016	0.99	No difference between oil-fired and gas-fired for VS and RAP <0.1
FF, RAP <0.1	8	0.0036	0.0033	VS, RAP <0.1	5	0.0040	0.0033	0.83	No difference between FF and VS for RAP <0.1

Table 4-23 (cont.)

Sample No. 1				Sample No. 2					
Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
VOLATILE ORGANIC COMPOUNDS									
Oil-fired	2	0.026	0.023	Gas-fired	3	0.016	0.0066	0.49	No difference between oil-fired and gas-fired
CARBON MONOXIDE									
Oil-fired	4	0.46	0.57	Gas-fired	6	0.45	0.51	0.97	No difference between oil-fired and gas-fired
CARBON DIOXIDE									
Waste oil-fired, RAP <0.1	10	35	7.1	Nonwaste oil-fired, RAP <0.1	18	36	21	0.86	No difference between waste oil-fired and non waste oil-fired for RAP <0.1
FF, waste oil-fired, RAP <0.1	7	35	3.9	FF, nonwaste oil-fired, RAP <0.1	17	37	21	0.80	No difference between waste oil-fired and non waste oil-fired for FF and RAP <0.1
FF, oil-fired, RAP <0.1	24	36	18	FF, gas-fired, RAP <0.1	20	46	37	0.22	No difference between oil-fired and gas-fired for FF and RAP <0.1
VS, oil-fired, RAP <0.1	4	32	12	VS, gas-fired	2	32	12	0.96	No difference between oil-fired and gas-fired for VS and RAP <0.1
FF, RAP <0.1	49	39	27	VS, RAP <0.1	6	32	11	0.57	No difference between FF and VS for RAP <0.1
NITROGEN OXIDES									
Oil-fired	2	0.12	0.076	Gas-fired	4	0.025	0.011	0.34	No difference between oil-fired and gas-fired

[a]FF = fabric filter. VS = venturi scrubber. WS = unspecified wet scrubber.

Table 4-24. SUMMARY OF LINEAR MODELS FIT TO BATCH MIX DATA[a]

Parameters modeled	Conditions	No. of obs.	Significant effects (p-value)	R^2	Equation
FILTERABLE PM					
R, P	FF	53	R (0.0067), P (0.033)	0.22	EF = 0.043 + 0.14R - 0.00012P
R	FF	54	R (0.0043)	0.15	EF = 0.020 + 0.16R
P	VS	9	P (0.039)	0.48	EF = 0.35 - 0.00094P
CONDENSABLE INORGANIC PM					
R*P	All data	17	R*P (<0.0001)	0.77	EF = 0.0041 + 0.00054RP
R	All data	17	R (0.0001)	0.61	EF = 0.0050 + 0.079R
CONDENSABLE ORGANIC PM					
R, R*P	All data	19	R (0.011), R*P (0.030)	0.35	EF = 0.0044 + 0.065R - 0.00018RP
CARBON DIOXIDE					
R, P, R*P	All data	62	R (0.052), P (0.0002), R*P (0.043)	0.23	EF = 75 - 170R - 0.18P + 0.67RP
P	All data	92	P (0.0009)	0.12	EF = 59 - 0.10P

[a] R^2 = squared correlation coefficient. R = percentage of RAP as a fraction. P = production rate in ton/hr. EF = emission factor in lb/ton. FF = fabric filter. VS = venturi scrubber, WS = unspecified wet scrubber.

Table 4-25. SUMMARY OF T-TESTS PERFORMED ON DRUM MIX DATA[a]

Sample No. 1				Sample No. 2					
Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
FILTERABLE PM									
FF, waste oil-fired, RAP <0.1	8	0.0095	0.0059	FF, nonwaste oil-fired, RAP <0.1	36	0.016	0.019	0.35	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP <0.1
VS, waste oil-fired, RAP <0.1	4	0.047	0.030	VS, nonwaste oil-fired, RAP <0.1	11	0.021	0.14	0.18	No difference between waste oil-fired and nonwaste oil-fired for VS and RAP <0.1
FF, oil-fired, RAP <0.1	44	0.015	0.018	FF, gas-fired, RAP <0.1	19	0.012	0.015	0.57	No difference between oil-fired and gas-fired for FF and RAP <0.1
VS, oil-fired, RAP <0.1	15	0.030	0.022	VS, gas-fired, RAP <0.1	8	0.018	0.015	0.25	No difference between oil-fired and gas-fired for VS and RAP <0.1
FF, RAP <0.1	66	0.014	0.016	VS, RAP <0.1	26	0.026	0.021	0.015	Differentiate between control devices for RAP <0.1
CONDENSABLE INORGANIC PM									
FF, waste oil-fired	4	0.013	0.011	FF, nonwaste oil-fired	8	0.0062	0.0040	0.12	No difference between waste oil-fired and nonwaste oil-fired for FF
FF, oil-fired, RAP <0.1	8	0.0080	0.0052	FF, gas-fired, RAP <0.1	3	0.0055	0.0050	0.49	No difference between oil-fired and gas-fired for FF and RAP <0.1
FF, RAP <0.1	12	0.0081	0.0054	VS, RAP <0.1	2	0.0038	0.00066	0.30	No difference between FF and VS for RAP <0.1
CONDENSABLE ORGANIC PM									
FF, waste oil-fired, RAP <0.1	12	0.016	0.015	FF, non waste oil-fired, RAP <0.1	7	0.0097	0.015	0.42	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP <0.1
VS, waste oil-fired	4	0.037	0.034	VS, non waste oil-fired	2	0.0037	0.0013	0.26	No difference between waste oil-fired and nonwaste oil-fired for VS
FF, oil-fired, RAP <0.1	8	0.0095	0.017	FF, gas-fired, RAP <0.1	2	0.0011	0.00056	0.51	No difference between oil-fired and gas-fired for FF and RAP <0.1
VS, oil-fired, RAP <0.1	2	0.0081	0.0074	VS, gas-fired, RAP <0.1	2	0.013	0.010	0.60	No difference between oil-fired and gas-fired for VS and RAP <0.1

Table 4-25 (cont.)

Sample No. 1				Sample No. 2					
Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
FF, RAP <0.1	11	0.0076	0.014	VS, RAP <0.1	5	0.0099	0.0070	0.74	No difference between FF and VS for RAP <0.1
VOLATILE ORGANIC COMPOUNDS									
FF, oil-fired	6	0.032	0.031	FF, gas-fired	5	0.058	0.042	0.28	No difference between oil-fired and gas-fired
FF, RAP <0.1	4	0.015	0.011	VS, RAP <0.1	3	0.058	0.022	0.060	Differentiate between FF and VS for RAP <0.1
CARBON MONOXIDE									
Oil-fired	6	0.18	0.22	Gas-fired	5	1.3	2.7	0.33	No difference between oil-fired and gas-fired
CARBON DIOXIDE									
FF, waste oil-fired, RAP <0.1	7	38	14	Nonwaste oil-fired, RAP <0.1	36	31	8.3	0.21	No difference between waste oil-fired and non waste oil-fired for FF and RAP <0.1
VS, waste oil-fired, RAP <0.1	3	38	9.8	VS, nonwaste oil-fired, RAP <0.1	11	34	16	0.68	No difference between waste oil-fired and non waste oil-fired for VS and RAP <0.1
FF, oil-fired, RAP <0.1	43	32	9.7	FF, gas-fired, RAP <0.1	17	25	9.3	0.016	Differentiate between oil-fired and gas-fired for FF and RAP <0.1
VS, oil-fired, RAP <0.1	14	35	14	VS, gas-fired, RAP <0.1	7	28	18	0.33	No difference between oil-fired and gas-fired for VS and RAP <0.1
FF, oil-fired, RAP <0.1	43	32	9.7	VS, oil-fired, RAP <0.1	14	35	14	0.34	No difference between FF and VS for oil-fired and RAP <0.1
FF, gas-fired, RAP <0.1	17	25	9.3	VS, gas-fired, RAP <0.1	7	28	18	0.61	No difference between FF and VS for gas-fired and RAP <0.1
NITROGEN OXIDES									
Oil-fired	5	0.051	0.024	Gas-fired	4	0.029	0.016	0.15	No difference between oil-fired and gas-fired

Table 4-25 (cont.)

Sample No. 1				Sample No. 2				P-value	Conclusion
Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.		
SULFUR DIOXIDE									
Waste oil-fired	3	0.091	0.073	Nonwaste oil-fired	4	0.0072	0.0053	0.18	No difference between waste oil-fired and oil-fired
Waste oil-fired, FF	3	0.091	0.073	Nonwaste oil-fired	2	0.012	0.0011	0.24	No difference between waste oil-fired and oil-fired for FF
FF, oil-fired	5	0.060	0.068	FF, gas-fired	3	0.0034	0.0019	0.21	No difference between oil-fired and gas-fired for FF
FF, RAP <0.1	3	0.18	0.30	VS, RAP <0.1	4	0.0043	0.0036	0.28	No difference between FF and VS for RAP <0.1

[a] FF = fabric filter. VS = venturi scrubber. WS = unspecified wet scrubber.

Table 4-26. SUMMARY OF LINEAR MODELS FIT TO DRUM MIX DATA[a]

Parameters modeled	Conditions	No. of obs.	Significant effects (p-value)	R^2	Equation
CONDENSABLE ORGANIC PM					
R	All data	36	R (0.047)	0.11	EF = 0.0074 + 0.033R
VOLATILE ORGANIC COMPOUNDS					
P	FF only	11	P (0.092)	0.28	EF = 0.11 - 0.00022P
NITROGEN OXIDES					
R, P	All data	5	R (0.041), P (0.016)	0.97	EF = 0.27 - 0.20R - 0.00059P

[a] R^2 = squared correlation coefficient. R = percentage of RAP as a fraction. P = production rate in ton/hr. EF = emission factor in lb/ton. FF = fabric filter. VS = venturi scrubber, WS = unspecified wet scrubber.

Table 4-27. REPORTED PARTICULATE-BASED LOAD-OUT EMISSIONS – PLANT C[a]

	Run 1 Loading		Run 2 Loading		Run 3 Loading		Background Run	
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362		-0.322		-0.284			
Load out Temperature (°F)	321		316		291			
90% Lower Confidence Limit Capture Efficiency	0.64		0.65		0.54			0.45
	Corrected For CE%		Corrected For CE%		Corrected For CE%		As Measured	Corrected For CE%
	gr/dscf	#/ton	gr/dscf	#/ton	gr/dscf	#/ton	gr/dscf	gr/dscf
Particulate[b]								
PM	1.92e-03	3.56e-04	1.14e-03	2.65e-04	1.59e-03	2.05e-04	7.93e-04	1.76e-03
MCEM	1.68e-03	3.12e-04	3.50e-04	8.16e-05	5.05e-04	6.52e-05	3.78e-04	8.40e-04
PAH			ppbvd	#/ton	ppbvd	#/ton	ppbvd	ppbvd
Acenaphthene			2.51e-01	1.57e-07	3.28e-01	1.24e-07	1.79e-02	3.97e-02
Acenaphthylene			2.62e-02	1.64e-08	3.87e-02	1.46e-08	2.60e-03	5.78e-03
Anthracene			8.20e-02	5.95e-08	6.24e-02	2.73e-08	6.19e-03	1.38e-02
Benzo(a)anthracene			1.39e-02	1.29e-08	1.37e-02	7.70e-09	3.29e-04	7.32e-04
Benzo(b)fluoranthene			5.45e-03	5.60e-09	5.21e-03	3.23e-09	3.58e-04	7.95e-04
Benzo(k)fluoranthene			1.60e-03	1.64e-09	1.36e-03	8.44e-10	ND[c]	ND[c]
Benzo(g,h,i)perylene			1.37e-03	1.54e-09	1.21e-03	8.19e-10	1.36e-04	3.02e-04
Benzo(a)pyrene			1.63e-03	1.68e-09	1.40e-03	8.69e-10	ND[c]	ND[c]
Benzo(e)pyrene			6.13e-03	6.30e-09	4.81e-03	2.98e-09	2.58e-04	5.73e-04
Chrysene			7.90e-02	7.35e-08	8.42e-02	4.72e-08	6.81e-03	1.51e-02
Dibenz(a,h)anthracene			4.94e-04	5.60e-10	ND[c]	ND[c]	ND[c]	ND[c]
Fluoranthene			5.10e-02	4.20e-08	4.65e-02	2.31e-08	7.44e-03	1.65e-02
Fluorene			1.09e+00	7.35e-07	5.96e-01	2.43e-07	4.83e-02	1.07e-01
Indeno(1,2,3-cd)pyrene			5.92e-04	7.00e-10	ND[c]	ND[c]	ND[c]	ND[c]
2-Methylnaphthalene			2.30e+00	1.33e-06	3.34e+00	1.17e-06	9.17e-02	2.04e-01
Naphthalene			1.27e+00	6.65e-07	1.89e+00	5.96e-07	ND[c]	ND[c]
Perylene			1.81e-02	1.85e-08	1.12e-02	6.95e-09	ND[c]	ND[c]
Phenanthrene			1.01e+00	7.35e-07	7.38e-01	3.23e-07	1.13e-01	2.51e-01
Pyrene			1.36e-01	1.12e-07	1.35e-01	6.70e-08	1.49e-02	3.31e-02
Other SVOHAP								
Phenol	ND[c]	ND[c]	ND[c]	ND[c]	5.70e+00	1.32e-06	ND[c]	ND[c]

[a] Reference 355

[b] Particulate and MCEM particulate deposition data presented in the test report are 1.34×10^{-4} and 8.68×10^{-4} respectively.

[c] ND - Measured data below detection limits.

Table 4-28. REPORTED VOLATILE ORGANIC LOAD-OUT EMISSIONS – PLANT C

	Run 1 Loading		Run 2 Loading		Run 3 Loading		Background Run	
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362		-0.322		-0.284			
Load out Temperature (°F)	321		316		291			
90% Lower Confidence Limit Capture Efficiency	0.64		0.65		0.54		0.45	
	Corrected For CE%		Corrected For CE%		Corrected For CE%		As Measured	Corrected For CE%
	ppm	#/ton	ppm	#/ton	ppm	#/ton	ppm	ppm
THC	1.11e+01	1.72e-03	1.18e+01	2.00e-03	1.43e+01	1.70e-03	0.83 [b]	1.84
Methane	5.00e+00	2.81e-04	4.77e+00	3.08e-04	6.11e+00	2.04e-04	3	6.67
Acetone (ppb)	1.28e+01	2.51e-06	6.62e+00	1.68e-06	2.31e+00	3.57e-07	2.00e+00	4.43e+00
CO	3.59e+00	3.44e-04	1.26e+01	1.43e-03	1.24e+01	7.41e-04	3.5	7.78
Ethylene	1.72e-01	1.72e-05	ND[c]	ND[c]	2.59e-01	1.56e-05	ND[c]	ND[c]
VOHAPS	ppb	#/ton	ppb	#/ton	ppb	#/ton	ppb	ppb
Benzene (M 0030)	6.82e+00	1.80e-06	4.39e+00	1.50e-06	3.33e+00	6.95e-07	1.07e+00	2.37e+00
Benzene (M 18)	ND[c]	ND[c]	1.06e+01	3.31e-06	ND[c]	ND[c]	ND[c]	ND[c]
Bromomethane	1.83e+00	5.89e-07	5.00e-01	2.08e-07	3.85e-02	9.76e-09	9.15e-02	2.03e-01
2-Butanone	5.61e+00	1.37e-06	5.06e+00	1.60e-06	1.68e+00	3.24e-07	2.67e-01	5.93e-01
Carbon Disulfide	4.66e-01	1.20e-07	1.57e+00	5.23e-07	5.00e-01	1.02e-07	ND[c]	ND[c]
Chloroethane	7.70e-02	1.68e-08	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]
Chloroform	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	1.90e-02	4.22e-02
Chloromethane	3.34e+00	5.72e-07	2.04e+00	4.51e-07	1.06e+00	1.43e-07	3.74e-01	8.31e-01
Cumene (M 0030)	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]
Cumene (M 18)	2.17e+01	9.03e-06	1.51e+01	7.29e-06	ND[c]	ND[c]	ND[c]	ND[c]
Ethylbenzene (M 0030)	2.47e+00	8.89e-07	6.79e-01	3.16e-07	1.45e+00	4.12e-07	1.46e-01	3.24e-01
Ethylbenzene (M 18)	5.02e+01	1.84e-05	6.22e+01	2.65e-05	2.24e+01	5.83e-06	1.55e+01	3.43e+01
Formaldehyde	ND[c]	ND[c]	ND[c]	ND[c]	4.44e-02	2.78e-06	ND[c]	ND[c]
n-Hexane (M 0030)	3.19e+00	9.32e-07	3.48e+00	1.31e-06	3.26e+00	7.50e-07	3.90e-01	8.67e-01
Hexane (M 18)	1.84e+01	5.50e-06	3.43e+01	1.19e-05	ND[c]	ND[c]	ND[c]	ND[c]
Isooctane	ND[c]	ND[c]	3.33e-01	1.67e-07	7.69e-02	2.34e-08	1.06e-01	2.35e-01
Methylene Chloride	7.23e+00	2.08e-06	3.34e+00	1.24e-06	1.19e+01	2.70e-06	1.21e+01	2.68e+01
MTBE	1.53e-01	4.57e-08	6.60e-01	2.55e-07	5.40e-01	1.27e-07	7.07e-01	1.57e+00
Styrene	ND[c]	ND[c]	4.60e-01	2.10e-07	7.17e-01	1.99e-07	1.45e-01	3.22e-01
Tetrachloromethane	3.94e-01	2.21e-07	3.19e-01	2.31e-07	2.91e-01	1.29e-07	8.65e-02	1.92e-01
Toluene (M 0030)	9.83e+00	3.07e-06	3.60e+00	1.45e-06	5.00e+00	1.23e-06	1.33e+00	2.95e+00

Table 4-28 (cont.)

	ppm	#/ton	ppm	#/ton	ppm	#/ton	ppm	ppm
Toluene (M 18)	2.67e+01	8.52e-06	4.48e+01	1.66e-05	2.12e+01	4.79e-06	1.05e+01	2.33e+01
1,1,1-Trichloroethane	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	3.40e-02	7.55e-02
Trichloromethane	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	ND[c]	2.87e-03	6.39e-03
Trichlorofluoromethane	8.78e-02	4.09e-08	1.11e-01	6.67e-08	1.49e-01	5.47e-08	7.42e-02	1.65e-01
m-/p-Xylene (M 0030)	1.44e+01	5.18e-06	3.84e+00	1.78e-06	7.08e+00	2.01e-06	4.09e-01	9.09e-01
m-Xylene (M 18)	1.09e+01	4.00e-06	1.04e+01	4.43e-06	ND[c]	ND[c]	ND[c]	ND[c]
p-Xylene (M 18)	3.25e+01	1.19e-05	2.03e+01	8.64e-06	ND[c]	ND[c]	ND[c]	ND[c]
Formaldehyde	ND[c]	ND[c]	ND[c]	ND[c]	4.44e-02	2.78e-06	ND[c]	ND[c]
o-Xylene (M 0030)	4.46e+00	1.60e-06	1.10e+00	5.12e-07	2.57e+00	7.28e-07	1.74e-01	3.87e-01
o-Xylene (M 18)	1.22e+01	4.47e-06	8.57e+00	3.65e-06	ND[c]	ND[c]	ND[c]	ND[c]

[a] Reference 355.

[b] The value presented is the average reported for the first half of the test period. The average reported for the second half of the test period was 1.6 ppm with a total run average of 1.2 ppm.

[c] ND - Measured data below detection limits.

Table 4-29. REPORTED LOAD-OUT EMISSIONS FOR PLANT D[a]

	Run 1	Run 2	Run 3	Deposition
	10/5/98	10/6/98	10/7/98	
Asphalt Loss on Heating (RTFOT)	-0.204	-0.246	-0.261	
Load out Temperature (F)	306.7	325.1	326.7	
	lb/ton	lb/ton	lb/ton	lb/ton
Particulate Matter (PM)	1.37e-03	1.78e-03	7.27e-04	3.37e-05[b]
MCEM	2.46e-04	1.50e-04	1.27e-04	3.58e-06
THC (ppm)	1.53e-03	1.71e-03	1.71e-03	

[a] Reference 356.
[b] Calculated from data reported in Appendix C and Appendix D of the PES test report.

Table 4-30. BACKGROUND-CORRECTED PARTICULATE BASED LOAD-OUT EMISSIONS – PLANT C

	Run 1 Loading		Run 2 Loading		Run 3 Loading	
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362		-0.322		-0.284	
Load out Temperature (°F)	321		316		291	
Particulate	gr/dscf	#/ton	gr/dscf	#/ton	gr/dscf	#/ton
PM	1.30e-03	2.41e-04	3.44e-04	8.01e-05	7.98e-04	1.03e-04
MCEM	1.30e-03	2.41e-04	-2.83e-05	0.00e+00[a]	1.27e-04	1.64e-05
PAH			ppbvd	#/ton	ppbvd	#/ton
Acenaphthene			2.33e-01	1.46e-07	3.10e-01	1.17e-07
Acenaphthylene			2.36e-02	1.48e-08	3.61e-02	1.37e-08
Anthracene			7.58e-02	5.50e-08	5.62e-02	2.46e-08
Benzo(a)anthracene			1.36e-02	1.26e-08	1.34e-02	7.51e-09
Benzo(b)fluoranthene			5.09e-03	5.23e-09	4.85e-03	3.01e-09
Benzo(k)fluoranthene			1.60e-03	1.64e-09	1.36e-03	8.44e-10
Benzo(g,h,i)perylene			1.23e-03	1.39e-09	1.07e-03	7.27e-10
Benzo(a)pyrene			1.63e-03	1.68e-09	1.40e-03	8.69e-10
Benzo(e)pyrene			5.87e-03	6.03e-09	4.55e-03	2.82e-09
Chrysene			7.22e-02	6.71e-08	7.74e-02	4.34e-08
Dibenz(a,h)anthracene			4.94e-04	5.60e-10	ND[b]	ND[b]
Fluoranthene			4.35e-02	3.58e-08	3.91e-02	1.94e-08
Fluorene			1.04e+00	7.02e-07	5.48e-01	2.24e-07
Indeno(1,2,3-cd)pyrene			5.92e-04	7.00e-10	ND[b]	ND[b]
2-Methylnaphthalene			2.20e+00	1.28e-06	3.25e+00	1.13e-06
Naphthalene			1.27e+00	6.65e-07	1.89e+00	5.96e-07
Perylene			1.81e-02	1.85e-08	1.12e-02	6.95e-09
Phenanthrene			9.00e-01	6.53e-07	6.25e-01	2.74e-07
Pyrene			1.21e-01	9.97e-08	1.20e-01	5.97e-08
Other SVOHAP						
Phenol	ND[b]	ND[b]	ND[b]	ND[b]	5.70e+00	1.32e-06

[a] Values presented as 0.00e+00 had background concentrations higher than the capture efficiency-corrected measured concentration.

[b] ND - Measured data below detection limits.

Table 4-31. BACKGROUND CORRECTED VOLATILE ORGANIC LOAD-OUT EMISSIONS – PLANT C

	Run 1 Loading		Run 2 Loading		Run 3 Loading	
Asphalt Loss on Heating (RTFOT)	-0.362		-0.322		-0.284	
Load out Temperature (F)	321		316		291	
	ppm	#/ton	ppm	#/ton	ppm	#/ton
THC	1.03e+01	1.59e-03	1.10e+01	1.86e-03	1.34e+01	1.60e-03
Methane	2.00e+00	1.13e-04	1.77e+00	1.14e-04	3.11e+00	1.04e-04
CO	9.37e-02	8.97e-06	9.12e+00	1.03e-03	8.91e+00	5.32e-04
Acetone (ppb)	1.08e+01	2.12e-06	4.62e+00	1.17e-06	3.10e-01	4.80e-08
Ethylene	1.72e-01	1.72e-05	ND[a]	ND[a]	2.59e-01	1.56e-05
VOHAPS	ppb	#/ton	ppb	#/ton	ppb	#/ton
Benzene (M 0030)	5.75e+00	1.52e-06	3.32e+00	1.13e-06	2.27e+00	4.72e-07
Benzene (M 18)	ND[a]	ND[a]	1.06e+01	3.31e-06	ND[a]	ND[a]
Bromomethane	1.74e+00	5.59e-07	4.08e-01	1.70e-07	-5.29e-02	0.00e+00[b]
2-Butanone	5.34e+00	1.30e-06	4.80e+00	1.51e-06	1.42e+00	2.73e-07
Carbon Disulfide	4.66e-01	1.20e-07	1.57e+00	5.23e-07	5.00e-01	1.02e-07
Chloroethane	7.70e-02	1.68e-08	ND[a]	ND[a]	ND[a]	ND[a]
Chloroform	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]
Chloromethane	2.97e+00	5.08e-07	1.67e+00	3.68e-07	6.84e-01	9.21e-08
Cumene (M 0030)	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]
Cumene (M 18)	2.17e+01	9.03e-06	1.51e+01	7.29e-06	ND[a]	ND[a]
Ethylbenzene (M 0030)	2.33e+00	8.37e-07	5.33e-01	2.48e-07	1.31e+00	3.71e-07
Ethylbenzene (M 18)	3.48e+01	1.28e-05	4.68e+01	1.99e-05	6.92e+00	1.80e-06
Formaldehyde (ppm)	ND[a]	ND[a]	ND[a]	ND[a]	4.44e-02	2.78e-06
n-Hexane (M 0030)	2.80e+00	8.19e-07	3.09e+00	1.17e-06	2.87e+00	6.60e-07
Hexane (M 18)	1.84e+01	5.50e-06	3.43e+01	1.19e-05	ND[a]	ND[a]
Isooctane	ND[a]	0.00e+00[b]	2.28e-01	1.14e-07	-2.89e-02	0.00e+00[b]
Methylene Chloride	-4.83e+00	0.00e+00[b]	-8.73e+00	0.00e+00[b]	-1.32e-01	0.00e+00[b]
MTBE	-5.54e-01	0.00e+00[b]	-4.62e-02	0.00e+00[b]	-1.67e-01	0.00e+00[b]
Styrene	ND[a]	ND[a]	3.15e-01	1.44e-07	5.72e-01	1.59e-07
Tetrachloromethane	3.07e-01	1.73e-07	2.32e-01	1.69e-07	2.05e-01	9.06e-08
Toluene (M 0030)	8.50e+00	2.65e-06	2.27e+00	9.17e-07	3.67e+00	9.02e-07
Toluene (M 18)	1.63e+01	5.19e-06	3.44e+01	1.27e-05	1.07e+01	2.42e-06

Table 4-31 (cont.)

VOHAPS	ppb	#/ton	ppb	#/ton	ppb	#/ton
1,1,1-Tri chloroethane	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]
Trichloromethane	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]	ND[a]
Trichlorofluoromethane	1.36e-02	6.33e-09	3.66e-02	2.20e-08	7.49e-02	2.75e-08
m-/p-Xylene (M 0030)	1.40e+01	5.03e-06	3.43e+00	1.59e-06	6.67e+00	1.89e-06
m-Xylene (M 18)	1.09e+01	4.00e-06	1.04e+01	4.43e-06	ND[a]	0.00e+00[b]
p-Xylene (M 18)	3.25e+01	1.19e-05	2.03e+01	8.64e-06	ND[a]	ND[a]
o-Xylene (M 0030)	4.28e+00	1.54e-06	9.27e-01	4.31e-07	2.40e+00	6.79e-07
o-Xylene (M 18)	1.22e+01	4.47e-06	8.57e+00	3.65e-06	ND[a]	ND[a]

[a] ND - Measured data below detection limits.

[b] Values presented as 0.00e+00 had background concentrations higher than the capture efficiency corrected measured concentration.

Table 4-32. ROLLING THIN FILM OVEN RESULTS FROM SELECTED STATES[a]

State	Number of Samples	Average loss on heating (ASTM D2872-88) (percent mass change)	Standard Deviation
Massachusetts	44	–0.232	0.124
Plant D - MA	3	–0.237	0.030
Connecticut	29	–0.355	0.147
North Carolina	226	–0.227	0.160
Michigan	32	–0.272	0.173
Minnesota	438	–0.440	0.289
Plant C - CA	13	–0.330	0.040

[a] References 355, 356 and 365 to 369.

Table 4-33. ROLLING FILM THICKNESS LOSS ON HEATING DATA[a]

Temperature (deg F)	Date	Loss on Heating (% by RTFOT)	Date	Loss on Heating (% by RTFOT)
California Test Data			Massachusetts Test Data	
300	07/24/98	–0.216	10/05/99	–0.089
	07/25/98	–0.200	10/06/99	–0.105
	07/27/98	–0.142	10/07/99	–0.109
	07/28/98	–0.171		
325	07/24/98	–0.369	10/05/99	–0.216
	07/25/98	–0.311	10/06/99	–0.206
	07/27/98	–0.286	10/07/99	–0.218
	07/28/98	–0.292		
350	07/24/98	–0.686	10/05/99	–0.400
	07/25/98	–0.611	10/06/99	–0.395
	07/27/98	–0.498	10/07/99	–0.380
	07/28/98	–0.510		

[a] References 355 and 356.

Table 4-34. TEMPERATURE AND VOLATILITY ADJUSTED PARTICULATE BASED LOAD-OUT EMISSIONS – PLANT C

	Run 1	Run 2	Run 3	Average	Speciation Profile
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362	-0.322	-0.284		
Load out Temperature (°F)	321	316	291		
90% Lower Confidence Limit Capture Efficiency	0.64	0.65	0.54		
Particulate[a]	#/ton	#/ton	#/ton	#/ton	
PM	3.66e-04	8.01e-05	1.50e-04	1.99e-04	
MCEM	3.66e-04	0.00e+00	6.34e-05	1.43e-04	
PAH		#/ton	#/ton	#/ton	PAH/MCEM (%)
Acenaphthene		2.79e-07	4.53e-07	3.66e-07	0.26%
Acenaphthylene		2.83e-08	5.28e-08	4.05e-08	0.028%
Anthracene		1.05e-07	9.50e-08	1.00e-07	0.070%
Benzo(a)anthracene		2.42e-08	2.90e-08	2.66e-08	0.019%
Benzo(b)fluoranthene		1.00e-08	1.16e-08	1.08e-08	0.0076%
Benzo(k)fluoranthene		3.14e-09	3.26e-09	3.20e-09	0.0022%
Benzo(g,h,i)perylene		2.65e-09	2.81e-09	2.73e-09	0.0019%
Benzo(a)pyrene		3.21e-09	3.36e-09	3.28e-09	0.0023%
Benzo(e)pyrene		1.15e-08	1.09e-08	1.12e-08	0.0078%
Chrysene		1.28e-07	1.67e-07	1.48e-07	0.103%
Dibenz(a,h)anthracene		1.07e-09	ND[b]	5.35e-10	0.00037%
Fluoranthene		6.85e-08	7.49e-08	7.17e-08	0.050%
Fluorene		1.34e-06	8.63e-07	1.10e-06	0.77%
Indeno(1,2,3-cd)pyrene		1.34e-09	ND[b]	6.69e-10	0.00047%
2-Methylnaphthalene		2.44e-06	4.38e-06	3.41e-06	2.38%
Naphthalene		1.27e-06	2.30e-06	1.79e-06	1.25%
Perylene		3.54e-08	2.68e-08	3.11e-08	0.022%
Phenanthrene		1.25e-06	1.06e-06	1.15e-06	0.81%
Pyrene		1.91e-07	2.30e-07	2.10e-07	0.15%
Other SVOHAPs					
Phenol	ND[b]	ND[b]	5.08e-06	1.69e-06	1.18%

[a] Adjusted Particulate and MCEM particulate deposition data presented in the test report are 1.45 x 10^{-4} and 1.93 x 10^{-5} respectively.

[b] ND - Measured data below detection limits.

Table 4-35. TEMPERATURE AND VOLATILITY ADJUSTED VOLATILE ORGANIC LOAD-OUT EMISSIONS – PLANT C

	Run 1	Run 2	Run 3	Average	Speciation Profile
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362	-0.322	-0.284		
Load out Temperature (°F)	321	316	291		
90% Lower Confidence Limit Capture Efficiency	0.64	0.65	0.54		
	#/ton	#/ton	#/ton	#/ton	VOHAP/THC (%)
THC[a]	2.41e-03	3.56e-03	6.20e-03	4.05e-03	
Methane	1.70e-04	2.18e-04	4.00e-04	2.63e-04	6.48%
Acetone	3.21e-06	2.25e-06	1.85e-07	1.88e-06	0.046%
CO	1.36e-05	1.98e-03	2.05e-03	1.35e-03	
Ethylene	2.60e-05	ND[b]	6.01e-05	2.87e-05	0.71%
TOC[c]				4.06e-03	
VOHAPS	#/ton	#/ton	#/ton	#/ton	
Benzene (M 0030)	2.31e-06	2.17e-06	1.82e-06		
Benzene (M 18)	ND	6.33e-06	ND		
Benzene (Average)				2.10e-06	0.052%
Bromomethane	8.47e-07	3.25e-07	0.00e+00[d]	3.91e-07	0.0096%
2-Butanone	1.98e-06	2.89e-06	1.05e-06	1.97e-06	0.049%
Carbon Disulfide	1.82e-07	1.00e-06	3.92e-07	5.25e-07	0.013%
Chloroethane	2.55e-08	ND	ND	8.50e-09	0.00021%
Chloroform	ND	ND	ND		
Chloromethane	7.70e-07	7.04e-07	3.56e-07	6.10e-07	0.015%
Cumene (M 0030)	ND	ND	ND		
Cumene (M 18)	1.37e-05	1.39e-05	ND		
Cumene (Average)				4.60e-06	0.11%
Ethylbenzene (M 0030)	1.27e-06	4.74e-07	1.43e-06		
Ethylbenzene (M 18)	1.93e-05	3.81e-05	6.96e-06		
Ethylbenzene (Average)				1.13e-05	0.28%
Formaldehyde	ND	ND	1.07e-05	3.58e-06	0.088%
n-Hexane (M 0030)	1.24e-06	2.23e-06	2.55e-06		
Hexane (M 18)	8.33e-06	2.27e-05	ND		
Hexane (Average)				6.17e-06	0.15%
Isooctane	ND	2.17e-07	0.00e+00	7.25e-08	0.0018%

Table 4-35 (cont.)

VOHAPS	#/ton	#/ton	#/ton	#/ton	
Methylene Chloride	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.0%
MTBE.	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.0%
Styrene	ND	2.75e-07	6.13e-07	2.96e-07	0.0073%
Tetrachloromethane	2.61e-07	3.22e-07	3.50e-07	3.11e-07	0.0077%
Toluene (M 0030)	4.02e-06	1.75e-06	3.48e-06		
Toluene (M 18)	7.86e-06	2.43e-05	9.35e-06		
Toluene (Average)				8.46e-06	0.21%
1,1,1-Tri chloroethane	ND	ND	ND	0.00e+00	0.0%
Trichloromethane	ND	ND	ND	0.00e+00	0.0%
Trichlorofluoromethane	9.58e-09	4.21e-08	1.06e-07	5.26e-08	0.0013%
m-/p-Xylene (M 0030)	7.63e-06	3.05e-06	7.29e-06		
m-Xylene (M 18)	6.06e-06	8.47e-06	ND		
p-Xylene (M 18)	1.81e-05	1.65e-05	ND		
m-/p-Xylene (Average)				1.66e-05	0.41%
o-Xylene (M 0030)	2.33e-06	8.23e-07	2.62e-06		
o-Xylene (M 18)	6.78e-06	6.98e-06	ND		
o-Xylene (Average)				3.26e-06	0.080%

[a] THC as propane, as measured with an EPA Method 25A sampling train or equivalent sampling train.
[b] ND - Measured data below detection limits.
[c] TOC equals THC plus formaldehyde.
[d] Values presented as 0.00e+00 had background concentrations higher than the capture efficiency corrected measured concentration.

Table 4-36. TEMPERATURE AND VOLATILITY ADJUSTED LOAD-OUT EMISSIONS – PLANT D

	Run 1	Run 2	Run 3		
	10/5/98	10/6/98	10/7/98	Average	
Asphalt Loss on Heating (RTFOT, % by weight)	-0.204	-0.246	-0.261	-0.237	
Load out Temperature (F)	306.7	325.1	326.7	319.5	
					Deposition
	lb/ton	lb/ton	lb/ton	lb/ton	lb/ton
Particulate Matter (PM)	2.11e-03	1.93e-03	8.33e-04	1.62e-03	3.89e-05[a]
MCEM	9.90e-04	3.04e-04	2.33e-04	5.09e-04	8.77e-06
THC (ppm)	6.16e-03	3.47e-03	3.13e-03	4.25e-03	

[a] Calculated from data reported in Appendix C and Appendix D of the PES test report.

Table 4-37. LOAD-OUT EMISSIONS AT -0.5% LOSS ON HEATING AND 325°F[a]

	Plant C Silo filling lb/ton	Plant C Load-out lb/ton	Plant D Load-out lb/ton
Total Particulate	5.85e-04	3.43e-04	1.67e-03
MCEM Particulate	2.53e-04	1.62e-04	5.18e-04
Inorganic Particulate	3.32e-04	1.81e-04	1.15e-03
THC	1.22e-02	4.05e-03	4.25e-03

[a] Particulate values represent the sum of the average values from sampling and deposition.

Table 4-38. REPORTED PARTICULATE BASED SILO FILLING EMISSIONS – PLANT C

	Run 1	Run 2	Run 3	Run 4
Asphalt Loss on Heating (RTFOT, % by Weight)	-0.362	-0.322	-0.284	-0.284
Load out Temperature (°F)	321	316	291	291
	lb/ton	lb/ton	lb/ton	
Particulate Matter (PM)[a]	5.95e-04	4.37e-04	1.53e-04	
MCEM[a]	2.06e-04	1.60e-04	3.51e-05	
PAHs		lb/ton	lb/ton	lb/ton
Acenaphthene		4.38e-07	2.46e-07	4.56e-07
Acenaphthylene		ND[b]	ND[b]	2.71e-08
Anthracene		1.31e-07	8.12e-08	1.16e-07
Benzo(a)anthracene		3.92e-08	3.77e-08	5.30e-08
Benzo(b)fluoranthene		ND[b]	ND[b]	ND[b]
Benzo(k)fluoranthene		ND[b]	ND[b]	ND[b]
Benzo(g,h,i)perylene		ND[b]	ND[b]	ND[b]
Benzo(a)pyrene		ND[b]	ND[b]	ND[b]
Benzo(e)pyrene		ND[b]	ND[b]	1.85e-08
Chrysene		1.48e-07	1.41e-07	1.97e-07
Dibenz(a,h)anthracene		ND[b]	ND[b]	ND[b]
Fluoranthene		1.27e-07	9.71e-08	1.23e-07
Fluorene		1.38e-06	4.93e-07	7.89e-07
Indeno(1,2,3-cd)pyrene		ND[b]	ND[b]	ND[b]
2-Methylnaphthalene		6.46e-06	2.90e-06	4.19e-06
Naphthalene		1.84e-06	1.04e-06	1.60e-06
Perylene		4.84e-08	ND[b]	3.45e-08
Phenanthrene		2.24e-06	9.28e-07	1.48e-06
Pyrene		5.30e-07	2.46e-07	3.58e-07

[a] Particulate and MCEM particulate deposition data presented in the test report are 7.12×10^{-5} and 1.12×10^{-6} lb/ton respectively.

[b] ND - Measured data below detection limits.

Table 4-39. REPORTED VOLATILE ORGANIC SILO FILLING EMISSIONS – PLANT C

	Run 1	Run 2	Run 3
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362	-0.322	-0.284
Load out Temperature (F)	321	316	291
	lb/ton	lb/ton	lb/ton
THC	5.3e-03	6.4e-03	4.2e-03
Methane	6.1e-05	1.2e-06	ND[aa]
CO	5.2e-04	1.4e-04	6.4e-04
Acetone	1.41e-06	4.98e-06	2.21e-06
Ethylene	2.2e-05	2.1e-06	9.4e-05
Volatile HAPs	lb/ton	lb/ton	lb/ton
Acrylonitrile	ND[a]	ND[a]	ND[a]
Allyl chloride	ND[a]	ND[a]	ND[a]
Benzene (M 0030)	2.53e-06	1.74e-06	1.15e-06
Bromodichloromethane	ND[a]	ND[a]	ND[a]
Bromoform	ND[a]	ND[a]	ND[a]
Bromomethane	2.54e-07	5.51e-07	8.96e-08
1,3-Butadiene	ND[a]	ND[a]	ND[a]
2-Butanone	ND[a]	3.40e-06	2.02e-06
Carbon Disulfide	ND[a]	2.29e-06	3.94e-07
Carbon tetrachloride	ND[a]	ND[a]	ND[a]
Chlorobenzene	ND[a]	ND[a]	ND[a]
Chloroethane	ND[a]	7.55e-07	ND[a]
Chloroform	ND[a]	ND[a]	ND[a]
Chloromethane	8.99e-07	2.80e-06	4.18e-07
Cumene (M 18)	ND[a]	ND[a]	ND[a]
Dibromochloromethane	ND[a]	ND[a]	ND[a]
1,2-Dibromoethane	ND[a]	ND[a]	ND[a]
1,1-Dichloroethane	ND[a]	ND[a]	ND[a]
1,2-Dichloroethane	ND[a]	ND[a]	ND[a]
1,1-Dichloroethene	ND[a]	ND[a]	ND[a]
cis-1,2-Dichloroethene	ND[a]	ND[a]	ND[a]
trans-1,2-Dichloroethene	ND[a]	ND[a]	ND[a]
1,2-Dichloropropane	ND[a]	ND[a]	ND[a]
cis-1,3-Dichloropropene	ND[a]	ND[a]	ND[a]
trans-1,3-Dichloropropene	ND[a]	ND[a]	ND[a]
1,2-Epoxybutane	ND[a]	ND[a]	ND[a]
Ethyl acrylate	ND[a]	ND[a]	ND[a]
Ethylbenzene (M 0030)	3.21e-06	9.37e-07	1.87e-06
Formaldehyde	1.3e-04	2.9e-05	ND[a]

Table 4-39 (cont.)

Volatile HAPs	lb/ton	lb/ton	lb/ton
n-Hexane (M 0030)	1.13e-05	3.46e-06	3.45e-06
2-Hexanone	ND[a]	ND[a]	ND[a]
Iodomethane	ND[a]	ND[a]	ND[a]
Isooctane	7.09e-08	2.43e-09	ND[a]
Methyl methacrylate	ND[a]	ND[a]	ND[a]
Methylene Chloride	5.01e-09	4.85e-08	ND[a]
MTBE	no data	no data	no data
Styrene	2.5e-09	3.54e-07	3.38e-07
1,1,2,2-Tetrachloroethane	ND[a]	ND[a]	ND[a]
Tetrachloromethane	ND[a]	ND[a]	ND[a]
Toluene (M 0030)	5.57e-06	2.01e-06	2.69e-06
1,1,1-Trichloroethane	ND[a]	ND[a]	ND[a]
1,1,2-Trichloroethane	ND[a]	ND[a]	ND[a]
Trichloromethane	ND[a]	ND[a]	ND[a]
Trichlorofluoromethane	ND[a]	ND[a]	ND[a]
Vinyl acetate	ND[a]	ND[a]	ND[a]
Vinyl bromide	ND[a]	ND[a]	ND[a]
Vinyl chloride	ND[a]	ND[a]	ND[a]
m-/p-Xylene (M 0030)	1.79e-05	5.12e-06	8.91e-06
o-Xylene (M 0030)	5.21e-06	1.90e-06	2.44e-06

[a] ND - Measured data below detection limits.

Table 4-40. TEMPERATURE AND VOLATILITY ADJUSTED PARTICULATE BASED SILO EMISSIONS – PLANT C

	Run 1	Run 2	Run 3	Run 4	Average	Speciation Profile
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362	-0.322	-0.284	-0.284		
Load out Temperature (°F)	321	316	291	291		
	lb/ton	lb/ton	lb/ton		lb/ton	
Particulate Matter (PM)[a]	7.01e-04	5.83e-04	2.53e-04		5.12e-04	
MCEM[a]	3.12e-04	3.06e-04	1.36e-04		2.51e-04	
PAHs	lb/ton	lb/ton	lb/ton	lb/ton	lb/ton	PAH/MCEM (%)
Acenaphthene		8.37e-07	9.50e-07	1.76e-06	1.18e-06	0.47%
Acenaphthylene		ND[b]	ND[b]	1.05e-07	3.49e-08	0.014%
Anthracene		2.50e-07	3.14e-07	4.48e-07	3.37e-07	0.13%
Benzo(a)anthracene		7.49e-08	1.46e-07	2.05e-07	1.42e-07	0.056%
Benzo(b)fluoranthene		ND[b]	ND[b]	ND[b]		
Benzo(k)fluoranthene		ND[b]	ND[b]	ND[b]		
Benzo(g,h,i)perylene		ND[b]	ND[b]	ND[b]		
Benzo(a)pyrene		ND[b]	ND[b]	ND[b]		
Benzo(e)pyrene		ND[b]	ND[b]	7.14e-08	2.38e-08	0.0095%
Chrysene		2.83e-07	5.44e-07	7.61e-07	5.29e-07	0.21%
Dibenz(a,h)anthracene		ND[b]	ND[b]	ND[b]		
Fluoranthene		2.43e-07	3.75e-07	4.75e-07	3.64e-07	0.15%
Fluorene		2.64e-06	1.90e-06	3.05e-06	2.53e-06	1.01%
Indeno(1,2,3-cd)pyrene		ND[b]	ND[b]	ND[b]		
2-Methylnaphthalene		1.23e-05	1.12e-05	1.62e-05	1.32e-05	5.27%
Naphthalene		3.52e-06	4.02e-06	6.18e-06	4.57e-06	1.82%
Perylene		9.25e-08	ND[b]	1.33e-07	7.52e-08	0.030%
Phenanthrene		4.28e-06	3.58e-06	5.71e-06	4.53e-06	1.80%
Pyrene		1.01e-06	9.50e-07	1.38e-06	1.12e-06	0.44%

[a] Adjusted Particulate and MCEM particulate deposition data presented in the test report are 7.26 x 10^{-5} and 2.49 x 10^{-6} lb/ton respectively.

[b] ND - Measured data below detection limits.

Table 4-41. TEMPERATURE AND VOLATILITY ADJUSTED VOLATILE ORGANIC SILO EMISSIONS – PLANT C

	Run 1	Run 2	Run 3	Average	Speciation Profile
Asphalt Loss on Heating (RTFOT, % by weight)	-0.362	-0.322	-0.284		
Load out Temperature (°F)	321	316	291		
	lb/ton	lb/ton	lb/ton	lb/ton	THC (%)
THC (ppm)[a]	8.03e-03	1.22e-02	1.62e-02	1.22e-02	
Methane	9.24e-05	2.29e-06	ND[b]	3.16e-05	0.26%
Acetone	2.14e-06	9.52e-06	8.53e-06	6.73e-06	0.055%
CO	7.88e-04	2.68e-04	2.47e-03	1.18e-03	
Ethylene	3.33e-05	4.01e-06	3.63e-04	1.33e-04	1.09%
TOC[c]				1.22e-02	
Volatile HAP	lb/ton	lb/ton	lb/ton	lb/ton	VOHAP/THC (%)
Acrylonitrile	ND[a]	ND[a]	ND[a]		
Allyl chloride	ND[a]	ND[a]	ND[a]		
Benzene (M 0030)	3.83e-06	3.33e-06	4.44e-06	3.87e-06	0.032%
Bromodichloromethane	ND[a]	ND[a]	ND[a]		
Bromoform	ND[a]	ND[a]	ND[a]		
Bromomethane	3.85e-07	1.05e-06	3.46e-07	5.95e-07	0.0049%
1,3-Butadiene	ND[a]	ND[a]	ND[a]		
2-Butanone	ND[a]	6.50e-06	7.80e-06	4.77e-06	0.039%
Carbon Disulfide	ND[a]	4.38e-06	1.52e-06	1.97e-06	0.016%
Carbon tetrachloride	ND[a]	ND[a]	ND[a]		
Chlorobenzene	ND[a]	ND[a]	ND[a]		
Chloroethane	ND[a]	1.44e-06	ND[a]	4.81e-07	0.0039%
Chloroform	ND[a]	ND[a]	ND[a]		
Chloromethane	1.36e-06	5.35e-06	1.61e-06	2.78e-06	0.023%
Cumene (M 18)	ND[a]	ND[a]	ND[a]		
Dibromochloromethane	ND[a]	ND[a]	ND[a]		
1,2-Dibromoethane	ND[a]	ND[a]	ND[a]		
1,1-Dichloroethane	ND[a]	ND[a]	ND[a]		
1,2-Dichloroethane	ND[a]	ND[a]	ND[a]		
1,1-Dichloroethene	ND[a]	ND[a]	ND[a]		
cis-1,2-Dichloroethene	ND[a]	ND[a]	ND[a]		
trans-1,2-Dichloroethene	ND[a]	ND[a]	ND[a]		
1,2-Dichloropropane	ND[a]	ND[a]	ND[a]		
cis-1,3-Dichloropropene	ND[a]	ND[a]	ND[a]		

Table 4-41 (cont.)

Volatile HAP	lb/ton	lb/ton	lb/ton	lb/ton	VOHAP/THC (%)
trans-1,3-Dichloropropene	ND[a]	ND[a]	ND[a]		
1,2-Epoxybutane	ND[a]	ND[a]	ND[a]		
Ethyl acrylate	ND[a]	ND[a]	ND[a]		
Ethylbenzene (M 0030)	4.86e-06	1.79e-06	7.22e-06	4.63e-06	0.038%
Formaldehyde	1.97e-04	5.54e-05	ND[a]	8.41e-05	0.69%
n-Hexane (M 0030)	1.71e-05	6.61e-06	1.33e-05	1.24e-05	0.10%
2-Hexanone	ND[a]	ND[a]	ND[a]		
Iodomethane	ND[a]	ND[a]	ND[a]		
Isooctane	1.07e-07	4.65e-09	ND[a]	3.74e-08	0.00031%
Methyl methacrylate	ND[a]	ND[a]	ND[a]		
Methylene Chloride	7.59e-09	9.27e-08	ND[a]	3.34e-08	0.00027%
MTBE	ND[a]	ND[a]	ND[a]		
Styrene	3.79e-09	6.77e-07	1.31e-06	6.62e-07	0.0054%
1,1,2,2-Tetrachloroethane	ND[a]	ND[a]	ND[a]		
Tetrachloromethane	ND[a]	ND[a]	ND[a]		
Toluene (M 0030)	8.44e-06	3.84e-06	1.04e-05	7.56e-06	0.062%
1,1,1-Tri chloroethane	ND[a]	ND[a]	ND[a]		
1,1,2-Tri chloroethane	ND[a]	ND[a]	ND[a]		
Trichloromethane	ND[a]	ND[a]	ND[a]		
Trichlorofluoromethane	ND[a]	ND[a]	ND[a]		
Vinyl acetate	ND[a]	ND[a]	ND[a]		
Vinyl bromide	ND[a]	ND[a]	ND[a]		
Vinyl chloride	ND[a]	ND[a]	ND[a]		
m-/p-Xylene (M 0030)	2.71e-05	9.79e-06	3.44e-05	2.38e-05	0.19%
o-Xylene (M 0030)	7.89e-06	3.63e-06	9.42e-06	6.98e-06	0.057%

[a] THC as propane, as measured with an EPA Method 25A sampling train or equivalent sampling train.
[b] ND - Measured data below detection limits.
[c] TOC equals THC plus formaldehyde.

Table 4-42. PREDICTED AND ADJUSTED LOSS-ON-HEATING VALUES

	California Asphalt		Massachusetts Asphalt	
Temperature (°F)	Predicted RTFOT (%)	Adjusted to -0.5 % RTFOT @ 325 °F	Predicted RTFOT (%)	Adjusted to -0.5 % RTFOT @ 325 °F
270	-0.0893	-0.1404	-0.0456	-0.1122
275	-0.1002	-0.1575	-0.0522	-0.1285
280	-0.1125	-0.1768	-0.0598	-0.1472
285	-0.1262	-0.1985	-0.0686	-0.1686
290	-0.1417	-0.2228	-0.0785	-0.1931
295	-0.1590	-0.2501	-0.0900	-0.2212
300	-0.1785	-0.2807	-0.1031	-0.2535
305	-0.2004	-0.3150	-0.1181	-0.2903
310	-0.2249	-0.3536	-0.1352	-0.3326
315	-0.2524	-0.3969	-0.1549	-0.3810
320	-0.2833	-0.4455	-0.1775	-0.4365
325	-0.3180	-0.5000	-0.2033	-0.5000
330	-0.3570	-0.5613	-0.2329	-0.5728

Table 4-43. SPECIATION PROFILES FOR ORGANIC PARTICULATE-BASED COMPOUNDS

Pollutant	Speciation Profile for Load-out Emissions	Speciation Profile for Silo Filling and Asphalt Storage Tank Emissions
PAH	PAH/MCEM (%)[a]	PAH/MCEM (%)
Acenaphthene	0.26%	0.47%
Acenaphthylene	0.028%	0.014%
Anthracene	0.070%	0.13%
Benzo(a)anthracene	0.019%	0.056%
Benzo(b)fluoranthene	0.0076%	ND[b]
Benzo(k)fluoranthene	0.0022%	ND[b]
Benzo(g,h,i)perylene	0.0019%	ND[b]
Benzo(a)pyrene	0.0023%	ND[b]
Benzo(e)pyrene	0.0078%	0.0095%
Chrysene	0.103%	0.21%
Dibenz(a,h)anthracene	0.00037%	ND[b]
Fluoranthene	0.050%	0.15%
Fluorene	0.77%	1.01%
Indeno(1,2,3-cd)pyrene	0.00047%	ND[b]
2-Methylnaphthalene	2.38%	5.27%
Naphthalene	1.25%	1.82%
Perylene	0.022%	0.030%
Phenanthrene	0.81%	1.80%
Pyrene	0.15%	0.44%
Other SVOHAPs		
Phenol	1.18%	ND[b]

[a] Emission Factor for compound is determined by multiplying the percentage presented for the compound by the emission factor for Organic Particulate.

[b] ND - Measured data below detection limits.

Table 4-44. SPECIATION PROFILES FOR ORGANIC VOLATILE ORGANIC-BASED COMPOUNDS

Pollutant	Speciation Profile for Load-Out and Yard Emissions.	Speciation Profile for Silo Filling and Asphalt Storage Tank Emissions
	COMPOUND/TOC (%)[a]	COMPOUND/TOC (%)
Methane	6.48%	0.26%
Acetone	0.046%	0.055%
Ethylene	0.71%	1.09%
VOHAPS		
Acrylonitrile	ND[b]	ND[b]
Allyl chloride	ND[b]	ND[b]
Benzene	0.052%	0.032%
Bromodichloromethane	ND[b]	ND[b]
Bromoform	ND[b]	ND[b]
Bromomethane	0.0096%	0.0049%
1,3-Butadiene	ND[b]	ND[b]
2-Butanone	0.049%	0.039%
Carbon Disulfide	0.013%	0.016%
Carbon tetrachloride	ND[b]	ND[b]
Chlorobenzene	ND[b]	ND[b]
Chloroethane	0.00021%	0.0039%
Chloroform	ND[b]	ND[b]
Chloromethane	0.015%	0.023%
Cumene	0.11%	ND[b]
Dibromochloromethane	ND[b]	ND[b]
1,2-Dibromoethane	ND[b]	ND[b]
1,1-Dichloroethane	ND[b]	ND[b]
1,2-Dichloroethane	ND[b]	ND[b]
1,1-Dichloroethene	ND[b]	ND[b]
cis-1,2-Dichloroethene	ND[b]	ND[b]
trans-1,2-Dichloroethene	ND[b]	ND[b]
1,2-Dichloropropane	ND[b]	ND[b]
cis-1,3-Dichloropropene	ND[b]	ND[b]
trans-1,3-Dichloropropene	ND[b]	ND[b]
1,2-Epoxybutane	ND[b]	ND[b]
Ethyl acrylate	ND[b]	ND[b]
Ethylbenzene	0.28%	0.038%
Formaldehyde	0.088%	0.69%
n-Hexane	0.15%	0.10%
2-Hexanone	ND[b]	ND[b]

Table 4-44 (cont.)

Pollutant	Speciation Profile for Load-Out and Yard Emissions.	Speciation Profile for Silo Filling and Asphalt Storage Tank Emissions
	COMPOUND/TOC (%)[a]	COMPOUND/TOC (%)
Iodomethane	ND[b]	ND[b]
Isooctane	0.0018%	0.00031%
Methyl methacrylate	ND[b]	ND[b]
Methylene Chloride	0.0%	0.00027%
MTBE	0.0%	ND[b]
Styrene	0.0073%	0.0054%
1,1,2,2-Tetrachloroethane	ND[b]	ND[b]
Tetrachloromethane	0.0077%	ND[b]
Toluene	0.21%	0.062%
1,1,1-Tri chloroethane	0.0%	ND[b]
1,1,2-Tri chloroethane	ND[b]	ND[b]
Trichloromethane	0.0%	ND[b]
Trichlorofluoromethane	0.0013%	ND[b]
Vinyl acetate	ND[b]	ND[b]
Vinyl bromide	ND[b]	ND[b]
Vinyl chloride	ND[b]	ND[b]
m-/p-Xylene	0.41%	0.19%
o-Xylene	0.080%	0.057%

[a] Emission Factor for compound is determined by multiplying the percentage presented for the compound by the emission factor for Total Organic Compounds (THC).
[b] ND - Measured data below detection limits.
[c] Values presented as 0.0% had background concentrations higher than the capture efficiency corrected measured concentration.

Table 4-45. SUMMARY OF CURVE-FITTING RESULTS FOR YARD EMISSIONS DATA

	Linear Function	Nonlinear (quadratic)	Nonlinear (power)
Equation (grams)	1.75*T + 0.96	-0.025*T^2 + 1.96*T + 0.64	2.45*T^0.855
r-squared	0.927	0.928	0.951
Time = 5 min	9.7 grams	9.8 grams	9.7 grams
Time = 8 min	15.0 grams	14.7 grams	14.5 grams
Time = 10 min	18.5 grams	17.7 grams	17.5 grams

Table 4-46. PREDICTIVE EMISSION FACTOR EQUATIONS FOR YARD EMISSIONS[a]

	Linear Function	Nonlinear (quadratic)	Nonlinear (power)
	lb/ton	lb/ton	lb/ton
Equation (lb/ton)	1.33 E-04*T + 7.30 E-05	-1.90 E-06*T^2+ 1.49 E-04*T + 4.87 E-06	1.86 E-04*T^0.855
Time = 5 min	7.37 E-04	7.45 E-04	7.37 E-04
Time = 8 min	1.14 E-03	1.12 E-03	1.10 E-03
Time = 10 min	1.41 E-03	1.35 E-03	1.33 E-03

[a] For the average asphalt load of 29 tons.

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APPENDIX A

RESULTS OF STATISTICAL ANALYSES OF BATCH MIX DRYER EMISSION DATA

This appendix presents the detailed results of the statistical analyses performed on the batch mix dryer data. The analyses were performed using STATA Statistical Software, Release 4.0. The following sections present the actual printouts of the analyses of the data for the following pollutants: filterable PM, condensable inorganic PM, condensable organic PM, VOC, CO, CO_2, and NO_x. The results of t-tests performed on the data are presented first, followed by the results of the analysis of variance (ANOVA) and regression models. Tables A-1 and A-2 provide descriptions of the variables used in the analyses. Table A-3 summarizes the results of the t-tests performed on the data, and Table A-4 summarizes the linear models fit to the data.

TABLE A-1. DESCRIPTION OF CATEGORICAL VARIABLES USED IN BATCH MIX DATA ANALYSIS

STATA variable	Description	STATA value	Actual name
poll	Pollutant	1	Filterable PM
		2	Condensible inorganic PM
		3	Condensible organic PM
		4	Filterable PM-10
		5	Condensible PM
		6	Volatile organic compounds (VOC)
		7	Carbon monoxide (CO)
		8	Carbon dioxide (CO_2)
		9	Nitrogen oxides (NO_x)
		10	Sulfur dioxide (SO_2)
		11	Back half
fuel	Fuel category	1	Oil
		2	Gas
		3	Coal/gas
		4	Coal/oil
apcd	Air pollution control device	1	Fabric filter
		2	Venturi scrubber or unspecified wet scrubber
wastem	Oil category	1	Waste oil or No. 6 oil
		2	Other types of fuel oil
		3	Gas
		4	Coal/gal
		5	Coal/oil

TABLE A-2. DESCRIPTION OF CONTINUOUS VARIABLES USED IN BATCH MIX DATA ANALYSIS[a]

STATA variable	Symbol in text	Description	Units	Range
rapm	R	Content RAP in mix	fraction (e.g., 0.2 for 20% RAP)	0 to *
ratem	P	Production rate	ton/hr	* to *

[a]NA = not applicable.

TABLE A-3. SUMMARY OF T-TESTS PERFORMED ON BATCH MIX DATA[a]

	Sample No. 1				Sample No. 2					
No.	Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
FILTERABLE PM										
1	FF, waste oil-fired, RAP < 0.1	8	0.021	0.024	FF, non waste oil-fired, RAP < 0.1	16	0.028	0.032	0.59	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP < 0.1
2	VS, waste oil-fired, RAP < 0.1	3	0.17	0.16	VS, non waste oil-fired, RAP < 0.1	2	0.042	0.015	0.34	No difference between waste oil-fired and nonwaste oil-fired for VS and RAP < 0.1
3	FF, oil-fired, RAP < 0.1	24	0.025	0.029	FF, gas-fired, RAP < 0.1	17	0.016	0.016	0.25	No difference between oil-fired and gas-fired for FF and RAP < 0.1
4	VS, oil-fired, RAP < 0.1	5	0.12	0.13	VS, gas-fired	2	0.21	0.26	0.53	No difference between oil-fired and gas-fired for VS and RAP < 0.1
5	FF, RAP < 0.1	46	0.020	0.024	VS, RAP < 0.1	7	0.15	0.16	0.078	Differentiate between control devices for RAP < 0.1
6	VS, RAP < 0.1	5	0.11	0.16	WS, RAP < 0.1	2	0.25	0.13	0.34	No difference between VS and WS for RAP < 0.1
CONDENSABLE INORGANIC PM										
1	FF, waste oil-fired	3	0.0093	0.015	FF, non waste oil-fired	8	0.012	0.022	0.87	No difference between waste oil-fired and nonwaste oil-fired for FF
2	FF, oil-fired, RAP < 0.1	4	0.0029	0.0014	FF, gas-fired, RAP < 0.1	9	0.0048	0.0043	0.42	No difference between oil-fired and gas-fired for FF and RAP < 0.1
3	FF, RAP < 0.1	13	0.0042	0.0037	VS, RAP < 0.1	3	0.0067	0.0083	0.38	No difference between FF and VS for RAP < 0.1
CONDENSABLE ORGANIC PM										
1	FF, waste oil-fired	4	0.0077	0.0075	FF, non waste oil-fired	3	0.0027	0.0046	0.36	No difference between waste oil-fired and nonwaste oil-fired for FF
2	FF, oil-fired	7	0.0055	0.0065	FF, gas-fired	8	0.0036	0.0033	0.48	No difference between oil-fired and gas-fired for FF
3	VS, oil-fired, RAP < 0.1	3	0.0040	0.0045	VS, gas-fired, RAP < 0.1	2	0.0040	0.0016	0.99	No difference between oil-fired and gas-fired for VS and RAP < 0.1
4	FF, RAP < 0.1	8	0.0036	0.0033	VS, RAP < 0.1	5	0.0040	0.0033	0.83	No difference between FF and VS for RAP < 0.1

TABLE A-3 (cont.)

No.	Sample No. 1 Description	No. of obs.	Mean EF	Std. dev.	Sample No. 2 Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
VOLATILE ORGANIC COMPOUNDS										
1	Oil-fired	2	0.026	0.023	Gas-fired	3	0.016	0.0066	0.49	No difference between oil-fired and gas-fired
CARBON MONOXIDE										
1	Oil-fired	4	0.46	0.57	Gas-fired	6	0.45	0.51	0.97	No difference between oil-fired and gas-fired
CARBON DIOXIDE										
1	Waste oil-fired, RAP < 0.1	10	35	7.1	Nonwaste oil-fired, RAP < 0.1	18	36	21	0.86	No difference between waste oil-fired and non waste oil-fired for RAP < 0.1
2	FF, waste oil-fired, RAP < 0.1	7	35	3.9	FF, nonwaste oil-fired, RAP < 0.1	17	37	21	0.80	No difference between waste oil-fired and non waste oil-fired for FF and RAP < 0.1
3	FF, oil-fired, RAP < 0.1	24	36	18	FF, gas-fired, RAP < 0.1	20	46	37	0.22	No difference between oil-fired and gas-fired for FF and RAP < 0.1
4	VS, oil-fired, RAP < 0.1	4	32	12	VS, gas-fired	2	32	12	0.96	No difference between oil-fired and gas-fired for VS and RAP < 0.1
5	FF, RAP < 0.1	49	39	27	VS, RAP < 0.1	6	32	11	0.57	No difference between FF and VS for RAP < 0.1
NITROGEN OXIDES										
1	Oil-fired	2	0.12	0.076	Gas-fired	4	0.025	0.011	0.34	No difference between oil-fired and gas-fired

[a]FF = fabric filter. VS = venturi scrubber. WS = unspecified wet scrubber.

TABLE A-4. SUMMARY OF LINEAR MODELS FIT TO BATCH MIX DATA[a]

No.	Parameters modeled	Conditions	No. of obs.	Significant effects (p-value)	R^2	Equation
FILTERABLE PM						
1	R, P, R*P	FF	53	P (0.077)		
2	R, P	FF	53	R (0.0067), P (0.033)	0.22	EF = 0.043 + 0.14R - 0.00012P
3	R	FF	54	R (0.0043)	0.15	EF = 0.020 + 0.16R
4	R, P, R*P	VS	8	P (0.065)		
5	R, P	VS	8	P (0.044)		
6	P	VS	9	P (0.039)	0.48	EF = 0.35 - 0.00094P
CONDENSABLE INORGANIC PM						
1	R, P, R*P	All data	17	R*P (0.065)		
2	R, R*P	All data	17	R*P (0.055)		
3	R*P	All data	17	R*P (<0.0001)	0.77	EF = 0.0041 + 0.00054RP
4	R, P	All data	17	R (<0.0001)		
5	R	All data	17	R (0.0001)	0.61	EF = 0.0050 + 0.079R
6	P	All data	17	None		
CONDENSABLE ORGANIC PM						
1	R, P, R*P	All data	19	R (0.029)		
2	R, R*P	All data	19	R (0.011), R*P (0.030)	0.35	EF = 0.0044 + 0.065R - 0.00018RP
3	R	All data	19	None		
CARBON MONOXIDE						
1	R, P, R*P	All data	6	None		
2	R, P	All data	6	None		
CARBON DIOXIDE						
1	R, P, R*P	All data	62	R (0.052), P (0.0002), R*P (0.043)	0.23	EF = 75 - 170R - 0.18P + 0.67RP
2	R, P	All data	62	P (0.0013)		
3	R	All data	63	None		
4	P	All data	92	P (0.0009)	0.12	EF = 59 - 0.10P

[a]R^2 = squared correlation coefficient. R = percentage of RAP. P = production rate in ton/hr. EF = emission factor in lb/ton. FF = fabric filter, VS = venturi scrubber, WS = unspecified wet scrubber.

A.1 FILTERABLE PM

A.1.1. Results of t-tests for Filterable PM

Filterable PM t-test No. 1
Comparison: Waste oil-fired vs. non waste oil-fired for FF and RAP < 0.1
Command: ttest ef if poll==1 & apcd==1 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	8	.0208387	.0236497
2	16	.0278167	.0318535
combined	24	.0254907	.0290386

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.55 with 22 d.f.
Pr > |t| = 0.5903

Filterable PM t-test No. 2
Comparison: Waste oil-fired vs. non waste oil-fired for VS and RAP < 0.1
Command: ttest ef if poll==1 & apcd==2 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	3	.1735333	.1553881
2	2	.0416667	.0146135
combined	5	.1207867	.1316919

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.14 with 3 d.f.
Pr > |t| = 0.3385

Filterable PM t-test No. 3
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==1 & apcd==1 & fuel<3 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	24	.0254907	.0290386
2	17	.0163467	.0158199
combined	41	.0216993	.0246125

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.18 with 39 d.f.
Pr > |t| = 0.2461

Filterable PM t-test No. 4
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==1 & apcd==2 & fuel<3 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	5	.1207867	.1316919
2	2	.2136667	.2635151
combined	7	.1473238	.158711

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.67 with 5 d.f.
Pr > |t| = 0.5347

Filterable PM t-test No. 5
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==1 & rap<0.1, by(apcd) unequal

Variable	Obs	Mean	Std. Dev.
1	46	.0201284	.0236928
2	7	.1473238	.158711
combined	53	.0369278	

Ho: mean(x) = mean(y) (assuming unequal variances)
t = -2.12 with 6.04 d.f.
Pr > |t| = 0.0783

Filterable PM t-test No. 6
Comparison: VS vs. WS for RAP < 0.1
Command: ttest ef if poll==1 & rap<0.1, by(vw)

Variable	Obs	Mean	Std. Dev.
1	5	.1075867	.1637849
2	2	.2466667	.1272792
combined	7	.1473238	.158711

Ho: mean(x) = mean(y) (assuming equal variances)
t = -1.06 with 5 d.f.
Pr > |t| = 0.3386

A.1.2. Results of Linear Model Analysis for Filterable PM

Filterable PM Model No. 1
Parameters: R, P, R*P
Conditions: FF

Command: anova ef rapm ratem rapm*ratem if poll==1 & apcd==1, cont(rapm ratem)

Number of obs = 53 R-squared = 0.2260
Root MSE = .026097 Adj R-squared = 0.1786

Source	Partial SS	df	MS	F	Prob > F
Model	.009742958	3	.003247653	4.77	0.0054
rapm	.001378489	1	.001378489	2.02	0.1612
ratem	.002223418	1	.002223418	3.26	0.0769
rapm*ratem	.000074674	1	.000074674	0.11	0.7420
Residual	.033370564	49	.000681032		
Total	.043113522	52	.000829106		

Filterable PM Model No. 2
Parameters: R, P
Conditions: FF

Command: anova ef rapm ratem if poll==1 & apcd==1, cont(rapm ratem)

Number of obs = 53 R-squared = 0.2243
Root MSE = .025863 Adj R-squared = 0.1932

Source	Partial SS	df	MS	F	Prob > F
Model	.009668283	2	.004834142	7.23	0.0017
rapm	.005344176	1	.005344176	7.99	0.0067
ratem	.003212796	1	.003212796	4.80	0.0331

```
              Residual |  .033445239    50  .000668905
            -----------+----------------------------------------------------
                 Total |  .043113522    52  .000829106
```

Command: regress

```
  Source |       SS       df       MS                  Number of obs =      53
---------+------------------------------               F(  2,    50) =    7.23
   Model | .009668283      2  .004834142               Prob > F      =  0.0017
Residual | .033445239     50  .000668905               R-squared     =  0.2243
---------+------------------------------               Adj R-squared =  0.1932
   Total | .043113522     52  .000829106               Root MSE      =  .02586

------------------------------------------------------------------------------
     efm        Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
------------------------------------------------------------------------------
_cons        .0434277    .011537      3.764   0.000        .020255    .0666004
rapm         .1444664   .0511103      2.827   0.007       .0418083    .2471246
ratem       -.0001157   .0000528     -2.192   0.033      -.0002218   -9.67e-06
------------------------------------------------------------------------------
```

<u>Filterable PM Model No. 3</u>
Parameters: R
Conditions: FF

Command: anova ef rap if poll==1 & apcd==1, cont(rap)

```
                           Number of obs =      54     R-squared     =  0.1463
                           Root MSE      =  .02665     Adj R-squared =  0.1299

                Source |  Partial SS    df       MS           F     Prob > F
            -----------+----------------------------------------------------
                 Model |  .006330472     1  .006330472       8.91     0.0043
                       |
                  rapm |  .006330472     1  .006330472       8.91     0.0043
                       |
              Residual |  .036932921    52  .000710248
            -----------+----------------------------------------------------
                 Total |  .043263393    53   .00081629
```

Command: regress

```
  Source |       SS       df       MS                  Number of obs =      54
---------+------------------------------               F(  1,    52) =    8.91
   Model | .006330472      1  .006330472               Prob > F      =  0.0043
Residual | .036932921     52  .000710248               R-squared     =  0.1463
---------+------------------------------               Adj R-squared =  0.1299
   Total | .043263393     53   .00081629               Root MSE      =  .02665
------------------------------------------------------------------------------
     efm        Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
------------------------------------------------------------------------------
_cons         .019932   .0038989      5.112   0.000       .0121083    .0277557
rapm         .1559074    .052222      2.985   0.004       .0511162    .2606986
------------------------------------------------------------------------------
```

<u>Filterable PM Model No. 4</u>
Parameters: R, P, R*P
Conditions: VS
Command: anova ef rapm ratem rapm*ratem if poll==1 & apcd==2, cont(rapm ratem)

```
                           Number of obs =       8     R-squared     =  0.6602
                           Root MSE      = .116473     Adj R-squared =  0.4054

                Source |  Partial SS    df       MS           F     Prob > F
            -----------+----------------------------------------------------
                 Model |  .105442267     3  .035147422       2.59     0.1901
```

```
                        |
                   rapm |  .00107529     1   .00107529       0.08     0.7923
                  ratem | .086270461     1  .086270461       6.36     0.0652
             rapm*ratem | .009764322     1  .009764322       0.72     0.4440
                        |
               Residual | .054263592     4  .013565898
             -----------+----------------------------------------------------
                  Total | .159705859     7  .022815123
```

Filterable PM Model No. 5
Parameters: R, P
Conditions: VS

Command: anova ef rapm ratem if poll==1 & apcd==2, cont(rapm ratem)

```
                           Number of obs =       8     R-squared     =  0.5991
                           Root MSE      = .113162     Adj R-squared =  0.4387

                 Source |  Partial SS    df       MS           F     Prob > F
             -----------+----------------------------------------------------
                  Model | .095677945     2  .047838972       3.74     0.1018
                        |
                   rapm | .019436339     1  .019436339       1.52     0.2727
                  ratem | .091878173     1  .091878173       7.17     0.0439
                        |
               Residual | .064027914     5  .012805583
             -----------+----------------------------------------------------
                  Total | .159705859     7  .022815123
```

Filterable PM Model No. 6
Parameters: R, P
Conditions: VS

Command: anova ef ratem if poll==1 & apcd==2, cont(ratem)

```
                           Number of obs =       9     R-squared     =  0.4802
                           Root MSE      = .109735     Adj R-squared =  0.4059

                 Source |  Partial SS    df       MS           F     Prob > F
             -----------+----------------------------------------------------
                  Model | .077855628     1  .077855628       6.47     0.0385
                        |
                  ratem | .077855628     1  .077855628       6.47     0.0385
                        |
               Residual | .084292847     7  .012041835
             -----------+----------------------------------------------------
                  Total | .162148475     8  .020268559
```

Command: regress

```
  Source |       SS       df       MS                  Number of obs =       9
---------+------------------------------               F(  1,     7) =    6.47
   Model | .077855628     1  .077855628                Prob > F      =  0.0385
Residual | .084292847     7  .012041835                R-squared     =  0.4802
---------+------------------------------               Adj R-squared =  0.4059
   Total | .162148475     8  .020268559                Root MSE      =  .10974

------------------------------------------------------------------------------
     efm        Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
------------------------------------------------------------------------------
_cons        .3488251    .088268      3.952   0.006       .1401046    .5575457
ratem       -.0009364   .0003683     -2.543   0.039      -.0018072   -.0000656
------------------------------------------------------------------------------
```

A.2 CONDENSABLE INORGANIC PM

A.2.1. Results of t-tests for Condensable Inorganic PM

Condensable Inorganic PM t-test No. 1
Comparison: Waste oil-fired vs. nonwaste oil-fired for FF
Command: ttest ef if poll==2 & apcd==1 & wastem<3, by(wastem)

```
  Variable |      Obs        Mean   Std. Dev.
 ---------+---------------------------------
         1 |        3    .0092873     .014965
         2 |        8    .0116324    .0222138
 ---------+---------------------------------
  combined |       11    .0109928     .019784

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                     t = -0.17 with 9 d.f.
               Pr > |t| = 0.8716
```

Condensable Inorganic PM t-test No. 2
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==2 & apcd==1 & fuel<3 & rap<0.1, by(fuel)

```
  Variable |      Obs        Mean   Std. Dev.
 ---------+---------------------------------
         1 |        4    .0029067    .0014118
         2 |        9    .0047623    .0042598
 ---------+---------------------------------
  combined |       13    .0041914    .0036593

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                     t = -0.83 with 11 d.f.
               Pr > |t| = 0.4226
```

Condensable Inorganic PM t-test No. 3
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==2 & rap<0.1, by(apcd)

```
  Variable |      Obs        Mean   Std. Dev.
 ---------+---------------------------------
         1 |       13    .0041914    .0036593
         2 |        3    .0068889    .0083255
 ---------+---------------------------------
  combined |       16    .0046972    .0045974

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                     t = -0.91 with 14 d.f.
               Pr > |t| = 0.3778
```

A.2.2. Results of Linear Model Analysis for Condensable Inorganic PM

Condensable Inorganic PM Model No. 1
Parameters: R, P, R*P
Conditions: None

Command: anova ef rapm ratem rapm*ratem if poll==2, cont(rapm ratem)

```
                           Number of obs =      17     R-squared     =  0.7991
                           Root MSE      = .003585     Adj R-squared =  0.7527

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .000664589     3   .00022153      17.23     0.0001
                         |
                    rapm |  .000022515     1  .000022515       1.75     0.2085
                   ratem |  1.3316e-06     1  1.3316e-06       0.10     0.7527
```

Source	Partial SS	df	MS	F	Prob > F
rapm*ratem	.000052249	1	.000052249	4.06	0.0649
Residual	.000167122	13	.000012856		
Total	.000831711	16	.000051982		

Condensable Inorganic PM Model No. 2
Parameters: R, R*P
Conditions: None

Command: anova ef rapm rapm*ratem if poll==2, cont(rapm ratem)

Number of obs = 17 R-squared = 0.7975
Root MSE = .003469 Adj R-squared = 0.7685

Source	Partial SS	df	MS	F	Prob > F
Model	.000663258	2	.000331629	27.56	0.0000
rapm	.000023282	1	.000023282	1.93	0.1859
rapm*ratem	.000052937	1	.000052937	4.40	0.0546
Residual	.000168453	14	.000012032		
Total	.000831711	16	.000051982		

Condensable Inorganic PM Model No. 3
Parameters: R*P
Conditions: None
Command: anova ef rapm*ratem if poll==2, cont(rapm ratem)

Number of obs = 17 R-squared = 0.7695
Root MSE = .003575 Adj R-squared = 0.7541

Source	Partial SS	df	MS	F	Prob > F
Model	.000639975	1	.000639975	50.07	0.0000
rapm*ratem	.000639975	1	.000639975	50.07	0.0000
Residual	.000191736	15	.000012782		
Total	.000831711	16	.000051982		

Command: regress

Source	SS	df	MS
Model	.000639975	1	.000639975
Residual	.000191736	15	.000012782
Total	.000831711	16	.000051982

Number of obs = 17
F(1, 15) = 50.07
Prob > F = 0.0000
R-squared = 0.7695
Adj R-squared = 0.7541
Root MSE = .00358

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	.0040732	.0009152	4.451	0.000	.0021225	.0060239
rapm*ratem	.0005392	.0000762	7.076	0.000	.0003768	.0007016

Condensable Inorganic PM Model No. 4
Parameters: R, P
Conditions: None
Command: anova ef rapm ratem if poll==2, cont(rapm ratem)

Number of obs = 17 R-squared = 0.7362

Root MSE = .003958 Adj R-squared = 0.6986

Source	Partial SS	df	MS	F	Prob > F
Model	.00061234	2	.00030617	19.54	0.0001
rapm	.000589875	1	.000589875	37.65	0.0000
ratem	2.0190e-06	1	2.0190e-06	0.13	0.7250
Residual	.000219371	14	.000015669		
Total	.000831711	16	.000051982		

<u>Condensable Inorganic PM Model No. 5</u>
Parameters: R
Conditions: None
Command: anova ef rapm if poll==2, cont(rapm)

Number of obs = 18 R-squared = 0.6108
Root MSE = .004764 Adj R-squared = 0.5864

Source	Partial SS	df	MS	F	Prob > F
Model	.000569839	1	.000569839	25.11	0.0001
rapm	.000569839	1	.000569839	25.11	0.0001
Residual	.000363154	16	.000022697		
Total	.000932992	17	.000054882		

Command: regress

Source	SS	df	MS
Model	.000569839	1	.000569839
Residual	.000363154	16	.000022697
Total	.000932992	17	.000054882

Number of obs = 18
F(1, 16) = 25.11
Prob > F = 0.0001
R-squared = 0.6108
Adj R-squared = 0.5864
Root MSE = .00476

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	.0049623	.0011764	4.218	0.001	.0024684	.0074562
rapm	.0790843	.0157834	5.011	0.000	.0456251	.1125435

<u>Condensable Inorganic PM Model No. 6</u>
Parameters: P
Conditions: None

Command: anova ef ratem if poll==2, cont(ratem)

Number of obs = 28 R-squared = 0.0326
Root MSE = .024609 Adj R-squared = -0.0047

Source	Partial SS	df	MS	F	Prob > F
Model	.000529771	1	.000529771	0.87	0.3582
ratem	.000529771	1	.000529771	0.87	0.3582
Residual	.015745817	26	.000605608		
Total	.016275588	27	.0006028		

A.3 CONDENSABLE ORGANIC PM

A.3.1. Results of t-tests for Condensable Organic PM

Condensable Organic PM t-test No. 1
Comparison: Waste oil-fired vs. nonwaste oil-fired for FF
Command: ttest ef if poll==3 & apcd==1 & wastem<3, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	4	.0076742	.0074651
2	3	.0026955	.0045652
combined	7	.0055404	.0064725

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.01 with 5 d.f.
Pr > |t| = 0.3595

Condensable Organic PM t-test No. 2
Comparison: Oil-fired vs. gas-fired for FF
Command: ttest ef if poll==3 & apcd==1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	7	.0055404	.0064725
2	8	.0036281	.0033104
combined	15	.0045206	.0049405

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.74 with 13 d.f.
Pr > |t| = 0.4751

Condensable Organic PM t-test No. 3
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==3 & apcd==2 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	3	.0040111	.0045402
2	2	.0040167	.0015792
combined	5	.0040133	.0033061

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.00 with 3 d.f.
Pr > |t| = 0.9988

Condensable Organic PM t-test No. 4
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==3 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	8	.0035832	.0033453
2	5	.0040133	.0033061
combined	13	.0037486	.0031967

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.23 with 11 d.f.
Pr > |t| = 0.8250

A.3.2. Results of Linear Model Analysis for Condensable Organic PM

Condensable Organic PM Model No. 1
Parameters: R, P, R*P
Conditions: None
Command: anova ef rapm ratem rapm*ratem if poll==3, cont(rapm ratem)

Number of obs =	19	R-squared =	0.3462
Root MSE =	.005066	Adj R-squared =	0.2155

Source	Partial SS	df	MS	F	Prob > F
Model	.000203904	3	.000067968	2.65	0.0868
rapm	.00015002	1	.00015002	5.84	0.0288
ratem	2.2642e-07	1	2.2642e-07	0.01	0.9264
rapm*ratem	.00007677	1	.00007677	2.99	0.1042
Residual	.000385014	15	.000025668		
Total	.000588919	18	.000032718		

Condensable Organic PM Model No. 2
Parameters: R, R*P
Conditions:
Command: anova ef rapm rapm*ratem if poll==3, cont(rapm ratem)

Number of obs =	19	R-squared =	0.3459
Root MSE =	.004907	Adj R-squared =	0.2641

Source	Partial SS	df	MS	F	Prob > F
Model	.000203678	2	.000101839	4.23	0.0335
rapm	.000197032	1	.000197032	8.18	0.0113
rapm*ratem	.000136207	1	.000136207	5.66	0.0302
Residual	.000385241	16	.000024078		
Total	.000588919	18	.000032718		

Command: regress

Source	SS	df	MS
Model	.000203678	2	.000101839
Residual	.000385241	16	.000024078
Total	.000588919	18	.000032718

Number of obs =	19
F(2, 16) =	4.23
Prob > F =	0.0335
R-squared =	0.3459
Adj R-squared =	0.2641
Root MSE =	.00491

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	.0044246	.0013291	3.329	0.004	.001607	.0072422
rapm	.0648414	.0226668	2.861	0.011	.0167899	.1128929
rapm*ratem	-.0001841	.0000774	-2.378	0.030	-.0003482	-.00002

Condensable Organic PM Model No. 3
Parameters: R, P, R*P
Conditions: None
Command: anova ef rapm if poll==3, cont(rapm)

Number of obs =	19	R-squared =	0.1146
Root MSE =	.005538	Adj R-squared =	0.0625

Source	Partial SS	df	MS	F	Prob > F
Model	.000067471	1	.000067471	2.20	0.1563
rapm	.000067471	1	.000067471	2.20	0.1563
Residual	.000521448	17	.000030673		
Total	.000588919	18	.000032718		

A.4 VOLATILE ORGANIC COMPOUNDS

A.4.1. Results of t-tests for VOC

Volatile Organic Compounds t-test No. 1
Comparison: Oil-fired vs. gas-fired
Command: ttest ef if poll==6, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	2	.0264444	.0227846
2	3	.0161963	.0065603
combined	5	.0202956	.0135207

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.79 with 3 d.f.
Pr > |t| = 0.4870

A.5 CARBON MONOXIDE

A.5.1. Results of t-tests for CO

Carbon Monoxide t-test No. 1
Comparison: Oil-fired vs. gas-fired
Command: ttest ef if poll==7, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	4	.4607222	.570815
2	6	.4472519	.5098287
combined	10	.45264	.5030519

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.04 with 8 d.f.
Pr > |t| = 0.9698

A.5.2. Results of Linear Model Analysis for CO

CO Model No. 1
Parameters: R, P, R*P
Conditions: None
Command: anova ef rapm ratem rapm*ratem if poll==7, cont(rapm ratem)

Number of obs = 6 R-squared = 0.3276
Root MSE = .38664 Adj R-squared = -0.1206

Source	Partial SS	df	MS	F	Prob > F
Model	.21851152	2	.10925576	0.73	0.5514
rapm	.197991985	1	.197991985	1.32	0.3332
ratem	.179585504	1	.179585504	1.20	0.3532
rapm*ratem	0.00	0			

Residual	.448472101	3	.1494907
Total	.666983621	5	.133396724

<u>CO Model No. 2</u>
Parameters: R, P
Conditions: None
Command: anova ef rapm ratem if poll==7, cont(rapm ratem)

Number of obs =	6	R-squared =	0.3276
Root MSE =	.38664	Adj R-squared =	-0.1206

Source	Partial SS	df	MS	F	Prob > F
Model	.21851152	2	.10925576	0.73	0.5514
rapm	.197991985	1	.197991985	1.32	0.3332
ratem	.179585504	1	.179585504	1.20	0.3532
Residual	.448472101	3	.1494907		
Total	.666983621	5	.133396724		

A.6 CARBON DIOXIDE

A.6.1. <u>Results of t-tests for CO_2</u>

<u>Carbon Dioxide t-test No. 1</u>
Comparison: Waste oil-fired vs. non waste oil-fired for RAP < 0.1
Command: ttest ef if poll==8 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	10	34.76167	7.053972
2	18	36	20.66587
combined	28	35.55774	16.90717

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.18 with 26 d.f.
Pr > |t| = 0.8567

<u>Carbon Dioxide t-test No. 2</u>
Comparison: Waste oil-fired vs. non waste oil-fired for RAP < 0.1
Command: ttest ef if poll==8 & apcd==1 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	7	34.60714	3.900663
2	17	36.68627	21.08941
combined	24	36.07986	17.72855

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.26 with 22 d.f.
Pr > |t| = 0.8005

<u>Carbon Dioxide t-test No. 3</u>
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==8 & apcd==1 & rap<0.1 & fuel<3, by(fuel)

Variable	Obs	Mean	Std. Dev.

	Obs	Mean	Std. Dev.
1	24	36.07986	17.72855
2	20	46.29075	35.69774
combined	44	40.72117	27.52529

Ho: mean(x) = mean(y) (assuming equal variances)
t = -1.23 with 42 d.f.
Pr > |t| = 0.2246

Carbon Dioxide t-test No. 4
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==8 & apcd==2 & rap<0.1 & fuel<3, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	4	32.425	12.15564
2	2	31.83333	12.49222
combined	6	32.22778	10.95263

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.06 with 4 d.f.
Pr > |t| = 0.9582

Carbon Dioxide t-test No. 5
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==8 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	49	38.64153	26.90336
2	6	32.22778	10.95263
combined	55	37.94185	25.66221

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.57 with 53 d.f.
Pr > |t| = 0.5682

A.6.2. Results of Linear Model Analysis for CO_2

CO_2 Model No. 1
Parameters: R, P, R*P
Conditions: None
Command: anova ef rapm ratem rapm*ratem if poll==8, cont(rapm ratem)

Number of obs = 62 R-squared = 0.2254
Root MSE = 22.4281 Adj R-squared = 0.1853

Source	Partial SS	df	MS	F	Prob > F
Model	8487.3474	3	2829.1158	5.62	0.0019
rapm	1987.12615	1	1987.12615	3.95	0.0516
ratem	8214.30645	1	8214.30645	16.33	0.0002
rapm*ratem	2147.50087	1	2147.50087	4.27	0.0433
Residual	29175.0181	58	503.017554		
Total	37662.3655	61	617.415828		

Command: regress

Source	SS	df	MS
Model	8487.3474	3	2829.1158
Residual	29175.0181	58	503.017554
Total	37662.3655	61	617.415828

Number of obs =	62
F(3, 58) =	5.62
Prob > F =	0.0019
R-squared =	0.2254
Adj R-squared =	0.1853
Root MSE =	22.428

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	75.05386	9.691284	7.744	0.000	55.65464	94.45307
rapm	-165.6651	83.35083	-1.988	0.052	-332.5099	1.179693
ratem	-.1800327	.044551	-4.041	0.000	-.2692112	-.0908542
rapm*ratem	.6709594	.324729	2.066	0.043	.0209436	1.320975

<u>CO_2 Model No. 2</u>
Parameters: R, P
Conditions: None
Command: anova ef rapm ratem if poll==8, cont(rapm ratem)

Number of obs =	62	R-squared =	0.1683
Root MSE =	23.0411	Adj R-squared =	0.1401

Source	Partial SS	df	MS	F	Prob > F
Model	6339.84653	2	3169.92326	5.97	0.0044
rapm	44.6913941	1	44.6913941	0.08	0.7727
ratem	6067.06551	1	6067.06551	11.43	0.0013
Residual	31322.519	59	530.890153		
Total	37662.3655	61	617.415828		

<u>CO_2 Model No. 3</u>
Parameters: R
Conditions: None
Command: anova ef rapm if poll==8, cont(rapm)

Number of obs =	63	R-squared =	0.0064
Root MSE =	24.8732	Adj R-squared =	-0.0098

Source	Partial SS	df	MS	F	Prob > F
Model	244.812329	1	244.812329	0.40	0.5317
rapm	244.812329	1	244.812329	0.40	0.5317
Residual	37739.3748	61	618.678275		
Total	37984.1871	62	612.648179		

<u>CO_2 Model No. 4</u>
Parameters: P
Conditions: None
Command: anova ef ratem if poll==8, cont(ratem)

Number of obs =	92	R-squared =	0.1161
Root MSE =	20.6549	Adj R-squared =	0.1063

Source	Partial SS	df	MS	F	Prob > F
Model	5045.13321	1	5045.13321	11.83	0.0009

ratem	5045.13321	1	5045.13321	11.83	0.0009
Residual	38396.3688	90	426.62632		
Total	43441.502	91	477.379143		

Command: regress

Source	SS	df	MS
Model	5045.13321	1	5045.13321
Residual	38396.3688	90	426.62632
Total	43441.502	91	477.379143

Number of obs	= 92
F(1, 90)	= 11.83
Prob > F	= 0.0009
R-squared	= 0.1161
Adj R-squared	= 0.1063
Root MSE	= 20.655

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	58.89581	6.661996	8.841	0.000	45.66059	72.13103
ratem	-.1009955	.029369	-3.439	0.001	-.1593422	-.0426488

A.7 NITROGEN OXIDES

A.7.1. Results of t-tests for NO_x

Nitrogen Oxides t-test No. 1
Comparison: Oil-fired vs. gas-fired
Command: ttest ef if poll==9, by(fuel) unequal

Variable	Obs	Mean	Std. Dev.
1	2	.1150444	.0761475
2	4	.0254063	.0105156
combined	6	.0552856	

Ho: mean(x) = mean(y) (assuming unequal variances)
t = 1.66 with 1.02 d.f.
Pr > |t| = 0.3423

APPENDIX B

RESULTS OF STATISTICAL ANALYSES OF DRUM MIX DRYER EMISSION DATA

This appendix presents the detailed results of the statistical analyses performed on the drum mix dryer data. The analyses were performed using STATA Statistical Software, Release 4.0. The following sections present the actual printouts of the analyses of the data for the following pollutants: filterable PM, condensable inorganic PM, condensable organic PM, VOC, CO, CO_2, NO_x, SO_2. The results of t-tests performed on the data are presented first, followed by the results of the analysis of variance (ANOVA) and regression models. Tables B-1 and B-2 provide descriptions of the variables used in the analyses. Table B-3 summarizes the results of the t-tests performed on the data, and Table B-4 summarizes the linear models fit to the data.

TABLE B-1. DESCRIPTION OF CATEGORICAL VARIABLES USED IN DRUM MIX DATA ANALYSIS

STATA variable	Description	STATA value	Actual name
poll	Pollutant	1	Filterable PM
		2	Condensible inorganic PM
		3	Condensible organic PM
		4	Filterable PM-10
		5	Condensible organic PM
		6	Volatile organic compounds (VOC)
		7	Carbon monoxide (CO)
		8	Carbon dioxide (CO_2)
		9	Nitrogen oxides (NO_x)
		10	Sulfur dioxide (SO_2)
		11	Back half
fuel	Fuel category	1	Oil
		2	Gas
		3	Coal/gas
		4	Coal/oil
apcd	Air pollution control device	1	Fabric filter
		2	Venturi scrubber or unspecified wet scrubber
wastem	Oil category	1	Waste oil or No. 6 oil
		2	Other types of fuel oil
		3	Gas
		4	Coal/gas
		5	Coal/oil

TABLE B-2. DESCRIPTION OF CONTINUOUS VARIABLES USED IN DRUM MIX DATA ANALYSIS[a]

STATA variable	Symbol in text	Description	Units	Range
rapm	R	Percentage of RAP in mix	Percent	0 to *
ratem	P	Production rate	ton/hr	* to *
pdm	ΔP	Scrubber pressure drop	inches of water	

[a]NA = not applicable.

TABLE B-3. SUMMARY OF T-TESTS PERFORMED ON DRUM MIX DATA[a]

No.	Sample No. 1 Description	No. of obs.	Mean EF	Std. dev.	Sample No. 2 Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
FILTERABLE PM										
1	FF, waste oil-fired, RAP < 0.1	8	0.0095	0.0059	FF, non waste oil-fired, RAP < 0.1	36	0.016	0.019	0.35	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP < 0.1
2	VS, waste oil-fired, RAP < 0.1	4	0.047	0.030	VS, non waste oil-fired, RAP < 0.1	11	0.021	0.14	0.18	No difference between waste oil-fired and nonwaste oil-fired for VS and RAP < 0.1
3	FF, oil-fired, RAP < 0.1	44	0.015	0.018	FF, gas-fired, RAP < 0.1	19	0.012	0.015	0.57	No difference between oil-fired and gas-fired for FF and RAP < 0.1
4	VS, oil-fired, RAP < 0.1	15	0.030	0.022	VS, gas-fired, RAP < 0.1	8	0.018	0.015	0.25	No difference between oil-fired and gas-fired for VS and RAP < 0.1
5	FF, RAP < 0.1	66	0.014	0.016	VS, RAP < 0.1	26	0.026	0.021	0.015	Differentiate between control devices for RAP < 0.1
CONDENSABLE INORGANIC PM										
1	FF, waste oil-fired	4	0.013	0.011	FF, non waste oil-fired	8	0.0062	0.0040	0.12	No difference between waste oil-fired and nonwaste oil-fired for FF
2	FF, oil-fired, RAP < 0.1	8	0.0080	0.0052	FF, gas-fired, RAP < 0.1	3	0.0055	0.0050	0.49	No difference between oil-fired and gas-fired for FF and RAP < 0.1
3	FF, RAP < 0.1	12	0.0081	0.0054	VS, RAP < 0.1	2	0.0038	0.00066	0.30	No difference between FF and VS for RAP < 0.1

TABLE B-3 (cont.)

No.	Sample No. 1 Description	No. of obs.	Mean EF	Std. dev.	Sample No. 2 Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
CONDENSABLE ORGANIC PM										
1	FF, waste oil-fired, RAP < 0.1	12	0.016	0.015	FF, non waste oil-fired, RAP < 0.1	7	0.0097	0.015	0.42	No difference between waste oil-fired and nonwaste oil-fired for FF and RAP < 0.1
2	VS, waste oil-fired	4	0.037	0.034	VS, non waste oil-fired	2	0.0037	0.0013	0.26	No difference between waste oil-fired and nonwaste oil-fired for VS
3	FF, oil-fired, RAP < 0.1	8	0.0095	0.017	FF, gas-fired, RAP < 0.1	2	0.0011	0.00056	0.51	No difference between oil-fired and gas-fired for FF and RAP < 0.1
4	VS, oil-fired, RAP < 0.1	2	0.0081	0.0074	VS, gas-fired, RAP < 0.1	2	0.013	0.010	0.60	No difference between oil-fired and gas-fired for VS and RAP < 0.1
5	FF, RAP < 0.1	11	0.0076	0.014	VS, RAP < 0.1	5	0.0099	0.0070	0.74	No difference between FF and VS for RAP < 0.1
VOLATILE ORGANIC COMPOUNDS										
1	FF, oil-fired	6	0.032	0.031	FF, gas-fired	5	0.058	0.042	0.28	No difference between oil-fired and gas-fired
2	FF, RAP < 0.1	4	0.015	0.011	VS, RAP < 0.1	3	0.058	0.022	0.060	Differentiate between FF and VS for RAP < 0.1
CARBON MONOXIDE										
1	Oil-fired	6	0.18	0.22	Gas-fired	5	1.3	2.7	0.33	No difference between oil-fired and gas-fired

TABLE B-3 (cont.)

No.	Sample No. 1 Description	No. of obs.	Mean EF	Std. dev.	Sample No. 2 Description	No. of obs.	Mean EF	Std. dev.	P-value	Conclusion
CARBON DIOXIDE										
1	FF, waste oil-fired, RAP < 0.1	7	38	14	Nonwaste oil-fired, RAP < 0.1	36	31	8.3	0.21	No difference between waste oil-fired and non waste oil-fired for FF and RAP < 0.1
2	VS, waste oil-fired, RAP < 0.1	3	38	9.8	VS, nonwaste oil-fired, RAP < 0.1	11	34	16	0.68	No difference between waste oil-fired and non waste oil-fired for VS and RAP < 0.1
3	FF, oil-fired, RAP < 0.1	43	32	9.7	FF, gas-fired, RAP < 0.1	17	25	9.3	0.016	Differentiate between oil-fired and gas-fired for FF and RAP < 0.1
4	VS, oil-fired, RAP < 0.1	14	35	14	VS, gas-fired, RAP < 0.1	7	28	18	0.33	No difference between oil-fired and gas-fired for VS and RAP < 0.1
5	FF, oil-fired, RAP < 0.1	43	32	9.7	VS, oil-fired, RAP < 0.1	14	35	14	0.34	No difference between FF and VS for oil-fired and RAP < 0.1
6	FF, gas-fired, RAP < 0.1	17	25	9.3	VS, gas-fired, RAP < 0.1	7	28	18	0.61	No difference between FF and VS for gas-fired and RAP < 0.1
NITROGEN OXIDES										
1	Oil-fired	5	0.051	0.024	Gas-fired	4	0.029	0.016	0.15	No difference between oil-fired and gas-fired

TABLE B-3 (cont.)

No.	Sample No. 1				Sample No. 2				P-value	Conclusion
	Description	No. of obs.	Mean EF	Std. dev.	Description	No. of obs.	Mean EF	Std. dev.		
SULFUR DIOXIDE										
1	Waste oil-fired	3	0.091	0.073	Non waste oil-fired	4	0.0072	0.0053	0.18	No difference between waste oil-fired and oil-fired
2	Waste oil-fired, FF	3	0.091	0.073	Non waste oil-fired	2	0.012	0.0011	0.24	No difference between waste oil-fired and oil-fired for FF
3	FF, oil-fired	5	0.060	0.068	FF, gas-fired	3	0.0034	0.0019	0.21	No difference between oil-fired and gas-fired for FF
4	FF, RAP < 0.1	3	0.18	0.30	VS, RAP < 0.1	4	0.0043	0.0036	0.28	No difference between FF and VS for RAP < 0.1

[a]FF = fabric filter. VS = venturi scrubber. WS = unspecified wet scrubber.

TABLE B-4. SUMMARY OF LINEAR MODELS FIT TO DRUM MIX DATA

No.	Parameters modeled	Conditions	No. of obs.	Significant effects (p-value)	R^2	Equation
FILTERABLE PM						
1	R, P, R*P	FF	108	P (0.0094)		
2	R, P	FF	108	P (0.020)		
3	P	FF	123	None		
4	R	FF	108	None		
5	R, P, R*P	VS	33	P (0.053)		
6	R, P	VS	33	None		
7	P	VS	36	None		
8	R	VS	33	None		
9	ΔP	VS	34	None		
10	ΔP	VS, oil-fired	20	None		
11	ΔP	VS, gas-fired	10	None		
CONDENSABLE INORGANIC PM						
1	R, P, R*P	All data	24	None		
2	R, P	All data	24	None		
CONDENSABLE ORGANIC PM						
1	R, P, R*P	All data	36	None		
2	R, P	All data	36	R (0.066)		
3	R	All data	36	R (0.047)	0.11	EF = 0.0074 + 0.033R
VOLATILE ORGANIC COMPOUNDS						
1	R, P, R*P	All data	12	P (0.093)		
2	R, P	All data	12	None		
3	R	All data	12	None		
4	R, P, R*P	FF only	9	None		
5	R, P	FF only	9	None		
6	R	FF only	9	None		
7	P	FF only	11	P (0.092)	0.28	EF = 0.11 - 0.00022P

TABLE B-4 (cont.)

No.	Parameters modeled	Conditions	No. of obs.	Significant effects (p-value)	R^2	Equation
CARBON MONOXIDE						
1	R, P, R*P	All data	7	None		
2	R, P	All data	7	None		
3	R	All data	7	None		
CARBON DIOXIDE						
1	R, P, R*P	FF, oil-fired	59	None		
2	R, P	FF, oil-fired	59	None		
3	R, P, R*P	FF, gas-fired	34	None		
4	R, P, R*P	VS, oil-fired	18	None		
5	R, P, R*P	VS, gas-fired	9	None		
6	R, P, R*P	FF	96	P (0.081)		
7	R, P	FF	96	None		
8	R	FF	96	None		
9	R, P, R*P	VS	30	None		
10	R, P, R*P	All data	126	None		
11	R, P	All data	126	None		
12	R	All data	126	None		
NITROGEN OXIDES						
1	R, P, R*P	All data	5	None		
2	R, P	All data	5	R (0.041), P (0.016)	0.97	EF = 0.27 - 0.20R - 0.00059P
SULFUR DIOXIDE						
1	R, P, R*P	All data	12	None		
2	R, P	All data	12	None		
3	R	All data	12	None		

[a]R^2 = squared correlation coefficient.

B.1 FILTERABLE PM

B.1.1. <u>Results of t-tests for Filterable PM</u>

<u>Filterable PM t-test No. 1</u>
Comparison: Waste oil-fired vs. non waste oil-fired for FF and RAP < 0.1
Command: ttest ef if poll==1 & apcd==1 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	8	.0095296	.005893
2	36	.0159718	.0190173
combined	44	.0148005	.0175027

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.94 with 42 d.f.
Pr > |t| = 0.3524

<u>Filterable PM t-test No. 2</u>
Comparison: Waste oil-fired vs. non waste oil-fired for VS and RAP < 0.1
Command:
ttest ef if poll==1 & apcd==2 & wastem<3 & rap<0.1, by(wastem) unequal

Variable	Obs	Mean	Std. Dev.
1	4	.0470803	.0301435
2	11	.0209458	.0138691
combined	15	.027915	

Ho: mean(x) = mean(y) (assuming unequal variances)
t = 1.67 with 3.47 d.f.
Pr > |t| = 0.1808

<u>Filterable PM t-test No. 3</u>
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==1 & apcd==1 & fuel<3 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	44	.0148005	.0175027
2	19	.0122165	.0145437
combined	63	.0140212	.0165922

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.56 with 61 d.f.
Pr > |t| = 0.5747

<u>Filterable PM t-test No. 4</u>
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==1 & apcd==2 & fuel<3 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	15	.027915	.0217993
2	8	.0177804	.014718
combined	23	.0243899	.0198919

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.17 with 21 d.f.
Pr > |t| = 0.2537

Filterable PM t-test No. 5
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==1 & rap<0.1, by(apcd) unequal

Variable	Obs	Mean	Std. Dev.
1	66	.0141773	.0163114
2	26	.0258898	.0210337
combined	92	.0174873	

Ho: mean(x) = mean(y) (assuming unequal variances)
t = -2.55 with 37.44 d.f.
Pr > |t| = 0.0149

B.1.2. Results of Linear Model Analysis for Filterable PM

Filterable PM Model No. 1
Parameters: R, P, R*P
Conditions: FF

Command: anova ef rapm ratem rapm*ratem if poll==1 & apcd==1, cont(rapm ratem)

Number of obs = 108 R-squared = 0.0805
Root MSE = .013242 Adj R-squared = 0.0540

Source	Partial SS	df	MS	F	Prob > F
Model	.001596173	3	.000532058	3.03	0.0325
rapm	.000366664	1	.000366664	2.09	0.1512
ratem	.001228686	1	.001228686	7.01	0.0094
rapm*ratem	.000278869	1	.000278869	1.59	0.2101
Residual	.018237081	104	.000175357		
Total	.019833254	107	.000185358		

Filterable PM Model No. 2
Parameters: R, P
Conditions: FF

Command: anova ef rapm ratem if poll==1 & apcd==1, cont(rapm ratem)

Number of obs = 108 R-squared = 0.0664
Root MSE = .013279 Adj R-squared = 0.0486

Source	Partial SS	df	MS	F	Prob > F
Model	.001317304	2	.000658652	3.74	0.0271
rapm	.000113396	1	.000113396	0.64	0.4244
ratem	.000989757	1	.000989757	5.61	0.0197
Residual	.01851595	105	.000176342		
Total	.019833254	107	.000185358		

Filterable PM Model No. 3
Parameters: P
Conditions: FF
Command: anova ef ratem if poll==1 & apcd==1, cont(ratem)

Number of obs = 123 R-squared = 0.0039
Root MSE = .015271 Adj R-squared = -0.0044

Source	Partial SS	df	MS	F	Prob > F
Model	.000109364	1	.000109364	0.47	0.4948
ratem	.000109364	1	.000109364	0.47	0.4948
Residual	.02821888	121	.000233214		
Total	.028328244	122	.000232199		

<u>Filterable PM Model No. 4</u>
Parameters: R
Conditions: FF

Command: anova ef rapm if poll==1 & apcd==1, cont(rapm)

```
Number of obs =     108     R-squared     =  0.0165
Root MSE      = .013565     Adj R-squared =  0.0072
```

Source	Partial SS	df	MS	F	Prob > F
Model	.000327547	1	.000327547	1.78	0.1850
rapm	.000327547	1	.000327547	1.78	0.1850
Residual	.019505707	106	.000184016		
Total	.019833254	107	.000185358		

<u>Filterable PM Model No. 5</u>
Parameters: R, P, R*P
Conditions: VS

Command:
anova efm rapm ratem rapm*ratem if poll==1 & apcd==2, cont(rapm ratem)

```
Number of obs =      33     R-squared     =  0.1495
Root MSE      = .018392     Adj R-squared =  0.0615
```

Source	Partial SS	df	MS	F	Prob > F
Model	.001723644	3	.000574548	1.70	0.1892
rapm	.000459815	1	.000459815	1.36	0.2531
ratem	.001382238	1	.001382238	4.09	0.0525
rapm*ratem	.00066461	1	.00066461	1.96	0.1716
Residual	.00980926	29	.00033825		
Total	.011532904	32	.000360403		

<u>Filterable PM Model No. 6</u>
Parameters: R, P
Conditions: VS

Command: anova efm rapm ratem if poll==1 & apcd==2, cont(rapm ratem)

```
Number of obs =      33     R-squared     =  0.0918
Root MSE      = .018685     Adj R-squared =  0.0313
```

Source	Partial SS	df	MS	F	Prob > F
Model	.001059035	2	.000529517	1.52	0.2358
rapm	.00042829	1	.00042829	1.23	0.2768
ratem	.000839386	1	.000839386	2.40	0.1315

```
            |
   Residual |   .01047387    30  .000349129
 -----------+----------------------------------------------------
      Total |  .011532904    32  .000360403
```

Filterable PM Model No. 7
Parameters: P
Conditions: VS

Command: anova efm ratem if poll==1 & apcd==2, cont(ratem)

```
                           Number of obs =      36     R-squared     =  0.0297
                           Root MSE      = .021968     Adj R-squared =  0.0012

     Source |  Partial SS    df       MS           F     Prob > F
 -----------+----------------------------------------------------
      Model |  .000502926     1  .000502926       1.04     0.3145
            |
      ratem |  .000502926     1  .000502926       1.04     0.3145
            |
   Residual |  .016407529    34  .000482574
 -----------+----------------------------------------------------
      Total |  .016910456    35  .000483156
```

Filterable PM Model No. 8
Parameters: R
Conditions: VS

Command: anova efm rapm if poll==1 & apcd==2, cont(rapm)

```
                           Number of obs =      33     R-squared     =  0.0190
                           Root MSE      = .019104     Adj R-squared = -0.0126

     Source |  Partial SS    df       MS           F     Prob > F
 -----------+----------------------------------------------------
      Model |  .000219649     1  .000219649       0.60     0.4437
            |
       rapm |  .000219649     1  .000219649       0.60     0.4437
            |
   Residual |  .011313255    31  .000364944
 -----------+----------------------------------------------------
      Total |  .011532904    32  .000360403
```

Filterable PM Model No. 9
Parameters: ΔP
Conditions: VS

Command: anova ef pd if poll==1, cont(pd)

```
                           Number of obs =      34     R-squared     =  0.0001
                           Root MSE      = .101489     Adj R-squared = -0.0311

     Source |  Partial SS    df       MS           F     Prob > F
 -----------+----------------------------------------------------
      Model |   .00003307     1   .00003307       0.00     0.9552
            |
        pdm |   .00003307     1   .00003307       0.00     0.9552
            |
   Residual |  .329597346    32  .010299917
 -----------+----------------------------------------------------
      Total |  .329630415    33    .0099888
```

Filterable PM Model No. 10
Parameters: ΔP
Conditions: VS, oil-fired
Command: anova ef pd if poll==1 & fuel==1, cont(pd)

Number of obs =	20	R-squared	=	0.0131
Root MSE	= .131288	Adj R-squared	=	-0.0417

Source	Partial SS	df	MS	F	Prob > F
Model	.004115	1	.004115	0.24	0.6310
pdm	.004115	1	.004115	0.24	0.6310
Residual	.310259604	18	.017236645		
Total	.314374604	19	.016546032		

Filterable PM Model No. 11
Parameters: ΔP
Conditions: VS, gas-fired
Command: anova ef pd if poll==1 & fuel==2, cont(pd)

Number of obs =	10	R-squared	=	0.1893
Root MSE	= .013409	Adj R-squared	=	0.0880

Source	Partial SS	df	MS	F	Prob > F
Model	.000335868	1	.000335868	1.87	0.2089
pdm	.000335868	1	.000335868	1.87	0.2089
Residual	.001438342	8	.000179793		
Total	.001774211	9	.000197135		

B.2 CONDENSABLE INORGANIC PM

B.2.1. Results of t-tests for Condensable Inorganic PM

Condensable Inorganic PM t-test No. 1
Comparison: Waste oil-fired vs. non waste oil-fired for FF
Command: ttest ef if poll==2 & apcd==1 & wastem<3, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	4	.0133583	.0108492
2	8	.0061808	.004026
combined	12	.0085733	.0074098

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.72 with 10 d.f.
Pr > |t| = 0.1169

Condensable Inorganic PM t-test No. 2
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==2 & apcd==1 & fuel<3 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	8	.0080208	.0051853
2	3	.0055256	.0047956
combined	11	.0073403	.0049779

Ho: mean(x) = mean(y) (assuming equal variances)
t = 0.72 with 9 d.f.
Pr > |t| = 0.4883

Condensable Inorganic PM t-test No. 3

Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==2 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	12	.0080897	.0054098
2	2	.0038	.00066
combined	14	.0074769	.0052176

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.08 with 12 d.f.
Pr > |t| = 0.2998

B.2.2. <u>Results of Linear Model Analysis for Condensable Inorganic PM</u>

<u>Condensable Inorganic PM Model No. 1</u>
Parameters: R, P, R*P
Conditions: None

Command: anova ef rapm ratem rapm*ratem if poll==2, cont(rapm ratem)

Number of obs = 24   R-squared = 0.0545
Root MSE = .006796   Adj R-squared = -0.0873

Source	Partial SS	df	MS	F	Prob > F
Model	.000053242	3	.000017747	0.38	0.7655
rapm	3.6999e-08	1	3.6999e-08	0.00	0.9777
ratem	.000016803	1	.000016803	0.36	0.5532
rapm*ratem	5.4193e-07	1	5.4193e-07	0.01	0.9148
Residual	.000923787	20	.000046189		
Total	.000977029	23	.00004248		

<u>Condensable Inorganic PM Model No. 2</u>
Parameters: R, P
Conditions: None

Command: anova ef rapm ratem if poll==2, cont(rapm ratem)

Number of obs = 24   R-squared = 0.0539
Root MSE = .006634   Adj R-squared = -0.0362

Source	Partial SS	df	MS	F	Prob > F
Model	.0000527	2	.00002635	0.60	0.5587
rapm	.000012591	1	.000012591	0.29	0.5984
ratem	.000019871	1	.000019871	0.45	0.5090
Residual	.000924329	21	.000044016		
Total	.000977029	23	.00004248		

B.3 CONDENSABLE ORGANIC PM

B.3.1. <u>Results of t-tests for Condensable Organic PM</u>

<u>Condensable Oganic PM t-test No. 1</u>
Comparison: Waste oil-fired vs. non waste oil-fired for FF and RAP < 0.1
Command: ttest ef if poll==3 & apcd==1 & wastem<3 & rap<0.1, by(wastem)

Variable	Obs	Mean	Std. Dev.

```
---------+-----------------------------------
       1 |         4    .0159375    .0229889
       2 |         4    .0030833    .0020411
---------+-----------------------------------
combined |         8    .0095104    .0165979

         Ho:  mean(x) = mean(y)  (assuming equal variances)
                   t = 1.11 with 6 d.f.
             Pr > |t| = 0.3079
```

<u>Condensable Organic PM t-test No. 2</u>
Comparison: Waste oil-fired vs. oil-fired for VS
Command: ttest ef if poll==3 & apcd==2 & wastem<3, by(wastem)

```
Variable |      Obs        Mean   Std. Dev.
---------+-----------------------------------
       1 |         4    .0369776    .0342788
       2 |         2    .0036683    .0012563
---------+-----------------------------------
combined |         6    .0258745    .0316418

         Ho:  mean(x) = mean(y)  (assuming equal variances)
                   t = 1.30 with 4 d.f.
             Pr > |t| = 0.2649
```

<u>Condensable Organic PM t-test No. 3</u>
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==3 & apcd==1 & fuel<3 & rap<0.1, by(fuel)

```
Variable |      Obs        Mean   Std. Dev.
---------+-----------------------------------
       1 |         8    .0095104    .0165979
       2 |         2    .0011017    .0005633
---------+-----------------------------------
combined |        10    .0078287    .0150624

         Ho:  mean(x) = mean(y)  (assuming equal variances)
                   t = 0.69 with 8 d.f.
             Pr > |t| = 0.5127
```

<u>Condensable Organic PM t-test No. 4</u>
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==3 & apcd==2 & fuel<3 & rap<0.1, by(fuel)

```
Variable |      Obs        Mean   Std. Dev.
---------+-----------------------------------
       1 |         2    .0080552    .0073659
       2 |         2    .0134833    .0100173
---------+-----------------------------------
combined |         4    .0107692     .007833

         Ho:  mean(x) = mean(y)  (assuming equal variances)
                   t = -0.62 with 2 d.f.
             Pr > |t| = 0.5999
```

<u>Condensable Organic PM t-test No. 5</u>
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==3 & rap<0.1, by(apcd)

```
Variable |      Obs        Mean   Std. Dev.
---------+-----------------------------------
       1 |        11     .007623    .0143057
       2 |         5    .0099421    .0070312
---------+-----------------------------------
combined |        16    .0083477    .0122821
```

```
           Ho:  mean(x) = mean(y)  (assuming equal variances)
                       t = -0.34 with 14 d.f.
               Pr > |t| = 0.7392
```

B.3.2. Results of Linear Model Analysis for Condensable Organic PM

Condensable Organic PM Model No. 1
Parameters: R, P, R*P
Conditions: All data

Command: anova ef rapm ratem rapm*ratem if poll==3, cont(rapm ratem)

```
                           Number of obs =      36     R-squared     =  0.1148
                           Root MSE      = .017659     Adj R-squared =  0.0318

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .001294064     3  .000431355       1.38     0.2657
                         |
                    rapm |  .000051198     1  .000051198       0.16     0.6880
                   ratem |  5.7558e-07     1  5.7558e-07       0.00     0.9660
             rapm*ratem  |  9.5872e-06     1  9.5872e-06       0.03     0.8619
                         |
                Residual |  .009978967    32  .000311843
              -----------+----------------------------------------------------
                   Total |  .011273031    35  .000322087
```

Condensable Organic PM Model No. 2
Parameters: R, P
Conditions: All data
Command: anova ef rapm ratem if poll==3, cont(rapm ratem)

```
                           Number of obs =      36     R-squared     =  0.1139
                           Root MSE      = .017398     Adj R-squared =  0.0602

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .001284476     2  .000642238       2.12     0.1359
                         |
                    rapm |  .001092036     1  .001092036       3.61     0.0663
                   ratem |  .000031175     1  .000031175       0.10     0.7503
                         |
                Residual |  .009988554    33  .000302683
              -----------+----------------------------------------------------
                   Total |  .011273031    35  .000322087
```

Condensable Organic PM Model No. 3
Parameters: R
Conditions: All data

Command: anova ef rapm if poll==3, cont(rapm)

```
                           Number of obs =      36     R-squared     =  0.1112
                           Root MSE      = .017167     Adj R-squared =  0.0850

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .001253301     1  .001253301       4.25     0.0469
                         |
                    rapm |  .001253301     1  .001253301       4.25     0.0469
                         |
                Residual |  .010019729    34  .000294698
              -----------+----------------------------------------------------
                   Total |  .011273031    35  .000322087
```

Command: regress

```
  Source |       SS       df       MS              Number of obs =      36
---------+------------------------------           F(  1,    34) =    4.25
   Model |  .001253301     1  .001253301           Prob > F      =  0.0469
Residual |  .010019729    34  .000294698           R-squared     =  0.1112
---------+------------------------------           Adj R-squared =  0.0850
   Total |  .011273031    35  .000322087           Root MSE      =  .01717
------------------------------------------------------------------------------
     efm        Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
------------------------------------------------------------------------------
_cons         .0073602   .0040267      1.828   0.076       -.000823    .0155434
rapm          .0332451   .0161209      2.062   0.047       .0004836    .0660067
------------------------------------------------------------------------------
```

B.4 VOLATILE ORGANIC COMPOUNDS

B.4.1. Results of t-tests for VOC

VOC t-test No. 1
Comparison: Oil-fired vs. gas-fired for FF
Command: ttest ef if poll==6 & apcd==1, by(fuel)

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+--------------------------------
         1 |        6    .0323435    .0308277
         2 |        5    .0575833     .042113
  ---------+--------------------------------
  combined |       11    .0438162    .0368553

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                     t = -1.15 with 9 d.f.
               Pr > |t| = 0.2802
```

VOC t-test No. 2
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==6 & rap<0.1, by(apcd) unequal

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+--------------------------------
         1 |        4    .0146583    .0112003
         2 |        3    .0575833    .0220331
  ---------+--------------------------------
  combined |        7    .0330548

           Ho:  mean(x) = mean(y)  (assuming unequal variances)
                     t = -3.09 with 2.78 d.f.
               Pr > |t| = 0.0595
```

B.4.2. Results of Linear Model Analysis for VOC

VOC Model No. 1
Parameters: R, P, R*P
Conditions: All data

Command: anova ef rapm ratem rapm*ratem if poll==6, cont(rapm ratem)

```
                           Number of obs =      12     R-squared     =  0.4296
                           Root MSE      = .031523     Adj R-squared =  0.2157

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .005986614     3  .001995538       2.01     0.1915
                         |
                    rapm |   .00112165     1   .00112165       1.13     0.3191
                   ratem |  .003600991     1  .003600991       3.62     0.0934
              rapm*ratem |  .001666455     1  .001666455       1.68     0.2314
                         |
```

Source	Partial SS	df	MS	F	Prob > F
Residual	.007949832	8	.000993729		
Total	.013936446	11	.00126695		

<u>VOC Model No. 2</u>
Parameters: R, P
Conditions: All data
Command: anova ef rapm ratem if poll==6, cont(rapm ratem)

Number of obs =	12	R-squared =	0.3100
Root MSE =	.032688	Adj R-squared =	0.1567

Source	Partial SS	df	MS	F	Prob > F
Model	.004320159	2	.002160079	2.02	0.1883
rapm	.000583964	1	.000583964	0.55	0.4786
ratem	.001975596	1	.001975596	1.85	0.2070
Residual	.009616287	9	.001068476		
Total	.013936446	11	.00126695		

<u>VOC Model No. 3</u>
Parameters: R
Conditions: All data

Command: anova ef rapm if poll==6, cont(rapm)

Number of obs =	12	R-squared =	0.1682
Root MSE =	.034047	Adj R-squared =	0.0851

Source	Partial SS	df	MS	F	Prob > F
Model	.002344563	1	.002344563	2.02	0.1854
rapm	.002344563	1	.002344563	2.02	0.1854
Residual	.011591883	10	.001159188		
Total	.013936446	11	.00126695		

<u>VOC Model No. 4</u>
Parameters: R, P, R*P
Conditions: FF only

Command: anova ef rap rate rap*rate if poll==6 & apcd==1, cont(rap rate)

Number of obs =	9	R-squared =	0.5261
Root MSE =	.034708	Adj R-squared =	0.2418

Source	Partial SS	df	MS	F	Prob > F
Model	.006686548	3	.002228849	1.85	0.2554
rapm	.000956434	1	.000956434	0.79	0.4137
ratem	.002959925	1	.002959925	2.46	0.1778
rapm*ratem	.001744355	1	.001744355	1.45	0.2827
Residual	.006023135	5	.001204627		
Total	.012709683	8	.00158871		

<u>VOC Model No. 5</u>
Parameters: R, P

Conditions: FF only

Command: anova ef rap rate if poll==6 & apcd==1, cont(rap rate)

Number of obs = 9 R-squared = 0.3889
Root MSE = .03598 Adj R-squared = 0.1851

Source	Partial SS	df	MS	F	Prob > F
Model	.004942193	2	.002471096	1.91	0.2283
rapm	.001425751	1	.001425751	1.10	0.3344
ratem	.001281254	1	.001281254	0.99	0.3582
Residual	.00776749	6	.001294582		
Total	.012709683	8	.00158871		

<u>VOC Model No. 6</u>
Parameters: R
Conditions: FF only

Command: anova ef rap if poll==6 & apcd==1, cont(rap)

Number of obs = 9 R-squared = 0.2880
Root MSE = .035954 Adj R-squared = 0.1863

Source	Partial SS	df	MS	F	Prob > F
Model	.003660939	1	.003660939	2.83	0.1363
rapm	.003660939	1	.003660939	2.83	0.1363
Residual	.009048744	7	.001292678		
Total	.012709683	8	.00158871		

<u>VOC Model No. 7</u>
Parameters: P
Conditions: FF only

Command: anova ef rate if poll==6 & apcd==1, cont(rate)

Number of obs = 11 R-squared = 0.2836
Root MSE = .032881 Adj R-squared = 0.2040

Source	Partial SS	df	MS	F	Prob > F
Model	.00385265	1	.00385265	3.56	0.0917
ratem	.00385265	1	.00385265	3.56	0.0917
Residual	.009730511	9	.001081168		
Total	.013583161	10	.001358316		

Command: regress

Source	SS	df	MS
Model	.00385265	1	.00385265
Residual	.009730511	9	.001081168
Total	.013583161	10	.001358316

Number of obs = 11
F(1, 9) = 3.56
Prob > F = 0.0917
R-squared = 0.2836
Adj R-squared = 0.2040
Root MSE = .03288

---

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	.1147887	.0388825	2.952	0.016	.0268304	.2027471
ratem	-.0002217	.0001175	-1.888	0.092	-.0004875	.000044

B.5 CARBON MONOXIDE

B.5.1. Results of t-tests for CO

CO t-test No. 1
Comparison: Oil-fired vs. gas-fired
Command: ttest ef if poll==7, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	6	.1769496	.2156134
2	5	1.293751	2.657994
combined	11	.6845868	1.785882

Ho: mean(x) = mean(y) (assuming equal variances)
t = -1.04 with 9 d.f.
Pr > |t| = 0.3270

B.5.2. Results of Linear Model Analysis for CO

CO Model No. 1
Parameters: R, P, R*P
Conditions: All data

Command: anova ef rapm ratem rapm*ratem if poll==7, cont(rapm ratem)

Number of obs = 7 R-squared = 0.5751
Root MSE = .170309 Adj R-squared = 0.1503

Source	Partial SS	df	MS	F	Prob > F
Model	.117790389	3	.039263463	1.35	0.4047
rapm	.025548716	1	.025548716	0.88	0.4172
ratem	.00423678	1	.00423678	0.15	0.7278
rapm*ratem	.024201153	1	.024201153	0.83	0.4284
Residual	.087015827	3	.029005276		
Total	.204806215	6	.034134369		

CO Model No. 2
Parameters: R, P
Conditions: All data
Command: anova ef rapm ratem if poll==7, cont(rapm ratem)

Number of obs = 7 R-squared = 0.4570
Root MSE = .166746 Adj R-squared = 0.1854

Source	Partial SS	df	MS	F	Prob > F
Model	.093589235	2	.046794618	1.68	0.2949
rapm	.001347606	1	.001347606	0.05	0.8365
ratem	.050258129	1	.050258129	1.81	0.2500
Residual	.11121698	4	.027804245		
Total	.204806215	6	.034134369		

CO Model No. 3
Parameters: R
Conditions: All data

Command: anova ef rapm if poll==7, cont(rapm)

```
                       Number of obs =       7     R-squared     =  0.2116
                       Root MSE      = .179708     Adj R-squared =  0.0539

              Source |  Partial SS    df       MS           F     Prob > F
          -----------+----------------------------------------------------
               Model |  .043331106     1  .043331106       1.34     0.2990
                     |
                rapm |  .043331106     1  .043331106       1.34     0.2990
                     |
            Residual |   .16147511     5  .032295022
          -----------+----------------------------------------------------
               Total |  .204806215     6  .034134369
```

B.6 CARBON DIOXIDE

B.5.1. Results of t-tests for CO_2

CO_2 t-test No. 1
Comparison: Waste oil-fired vs. non waste oil-fired for FF and RAP < 0.1
Command:
ttest ef if poll==8 & wastem<3 & apcd==1 & rap<0.1, by(wastem) unequal

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
         1 |        7    38.27143    14.13274
         2 |       36    30.71505    8.303645
  ---------+---------------------------------
  combined |       43    31.94516

           Ho:  mean(x) = mean(y)  (assuming unequal variances)
                      t = 1.37 with 6.83 d.f.
               Pr > |t| = 0.2142
```

CO_2 t-test No. 2
Comparison: Waste oil-fired vs. non waste oil-fired for VS and RAP < 0.1
Command: ttest ef if poll==8 & wastem<3 & apcd==2 & rap<0.1, by(wastem)

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
         1 |        3     38.3596    9.765434
         2 |       11    34.31606    15.69357
  ---------+---------------------------------
  combined |       14    35.18253    14.39056

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                      t = 0.42 with 12 d.f.
               Pr > |t| = 0.6837
```

CO_2 t-test No. 3
Comparison: Oil-fired vs. gas-fired for FF and RAP < 0.1
Command: ttest ef if poll==8 & fuel<3 & apcd==1 & rap<0.1, by(fuel)

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
         1 |       43    31.94516    9.693272
         2 |       17    25.14552    9.322651
  ---------+---------------------------------
  combined |       60    30.01859    10.00016
```

Ho: mean(x) = mean(y) (assuming equal variances)
t = 2.47 with 58 d.f.
Pr > |t| = 0.0163

CO_2 t-test No. 4
Comparison: Oil-fired vs. gas-fired for VS and RAP < 0.1
Command: ttest ef if poll==8 & fuel<3 & apcd==2 & rap<0.1, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	14	35.18253	14.39056
2	7	27.99595	17.8402
combined	21	32.78701	15.56085

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.00 with 19 d.f.
Pr > |t| = 0.3310

CO_2 t-test No. 5
Comparison: FF vs. VS for oil-fired and RAP < 0.1
Command: ttest ef if poll==8 & fuel==1 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	43	31.94516	9.693272
2	14	35.18253	14.39056
combined	57	32.7403	10.97817

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.96 with 55 d.f.
Pr > |t| = 0.3424

CO_2 t-test No. 6
Comparison: FF vs. VS for gas-fired and RAP < 0.1
Command: ttest ef if poll==8 & fuel==2 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	17	25.14552	9.322651
2	7	27.99595	17.8402
combined	24	25.97689	12.05154

Ho: mean(x) = mean(y) (assuming equal variances)
t = -0.52 with 22 d.f.
Pr > |t| = 0.6095

B.6.2. Results of Linear Model Analysis for CO_2

CO_2 Model No. 1
Parameters: R, P, R*P
Conditions: FF, oil-fired
Command:
anova ef rapm ratem rapm*ratem if poll==8 & apcd==1 & fuel==1, cont(rapm ratem)

Number of obs = 59 R-squared = 0.0117
Root MSE = 11.6932 Adj R-squared = -0.0422

Source	Partial SS	df	MS	F	Prob > F
Model	89.2079924	3	29.7359975	0.22	0.8839

	Partial SS	df	MS	F	Prob > F
rapm	5.16801432	1	5.16801432	0.04	0.8466
ratem	55.547418	1	55.547418	0.41	0.5265
rapm*ratem	25.4321656	1	25.4321656	0.19	0.6680
Residual	7520.18731	55	136.730678		
Total	7609.39531	58	131.196471		

CO_2 Model No. 2
Parameters: R, P
Conditions: FF, oil-fired
Command: anova ef rapm ratem if poll==8 & apcd==1 & fuel==1, cont(rapm ratem)

Number of obs = 59 R-squared = 0.0084
Root MSE = 11.6079 Adj R-squared = -0.0270

Source	Partial SS	df	MS	F	Prob > F
Model	63.7758269	2	31.8879134	0.24	0.7900
rapm	53.2176024	1	53.2176024	0.39	0.5323
ratem	30.1304219	1	30.1304219	0.22	0.6381
Residual	7545.61948	56	134.743205		
Total	7609.39531	58	131.196471		

CO_2 Model No. 3
Parameters: R, P, R*P
Conditions: FF, gas-fired
Command:
anova ef rapm ratem rapm*ratem if poll==8 & apcd==1 & fuel==2, cont(rapm ratem)

Number of obs = 34 R-squared = 0.0326
Root MSE = 9.65883 Adj R-squared = -0.0642

Source	Partial SS	df	MS	F	Prob > F
Model	94.2599773	3	31.4199924	0.34	0.7988
rapm	8.01157907	1	8.01157907	0.09	0.7715
ratem	64.3210424	1	64.3210424	0.69	0.4129
rapm*ratem	18.429114	1	18.429114	0.20	0.6599
Residual	2798.79069	30	93.2930229		
Total	2893.05066	33	87.6682019		

CO_2 Model No. 4
Parameters: R, P, R*P
Conditions: VS, oil-fired
Command:
anova ef rapm ratem rapm*ratem if poll==8 & apcd==2 & fuel==1, cont(rapm ratem)

Number of obs = 18 R-squared = 0.2704
Root MSE = 13.7181 Adj R-squared = 0.1141

Source	Partial SS	df	MS	F	Prob > F
Model	976.662216	3	325.554072	1.73	0.2067
rapm	137.485254	1	137.485254	0.73	0.4071
ratem	135.879179	1	135.879179	0.72	0.4098

rapm*ratem	257.345768	1	257.345768	1.37	0.2618
Residual	2634.61869	14	188.187049		
Total	3611.2809	17	212.428288		

CO_2 Model No. 5
Parameters: R, P, R*P
Conditions: VS, gas-fired
Command:

```
anova ef rapm ratem rapm*ratem if poll==8 & apcd==2 & fuel==2, cont(rapm
ratem)
```

Number of obs = 9 R-squared = 0.1634
Root MSE = 18.0319 Adj R-squared = -0.3386

Source	Partial SS	df	MS	F	Prob > F
Model	317.460772	3	105.820257	0.33	0.8078
rapm	238.744789	1	238.744789	0.73	0.4306
ratem	282.545822	1	282.545822	0.87	0.3940
rapm*ratem	256.099662	1	256.099662	0.79	0.4155
Residual	1625.74337	5	325.148673		
Total	1943.20414	8	242.900517		

CO_2 Model No. 6
Parameters: R, P, R*P
Conditions: FF
Command: anova ef rapm ratem rapm*ratem if poll==8 & apcd==1, cont(rapm
ratem)

Number of obs = 96 R-squared = 0.0350
Root MSE = 10.9807 Adj R-squared = 0.0036

Source	Partial SS	df	MS	F	Prob > F
Model	402.701995	3	134.233998	1.11	0.3479
rapm	92.9675725	1	92.9675725	0.77	0.3822
ratem	374.687384	1	374.687384	3.11	0.0813
rapm*ratem	171.802039	1	171.802039	1.42	0.2357
Residual	11092.9505	92	120.575549		
Total	11495.6525	95	121.006869		

CO_2 Model No. 7
Parameters: R, P
Conditions: FF
Command: anova ef rapm ratem if poll==8 & apcd==1, cont(rapm ratem)

Number of obs = 96 R-squared = 0.0201
Root MSE = 11.0057 Adj R-squared = -0.0010

Source	Partial SS	df	MS	F	Prob > F
Model	230.899956	2	115.449978	0.95	0.3893
rapm	74.8344081	1	74.8344081	0.62	0.4339
ratem	203.854184	1	203.854184	1.68	0.1977
Residual	11264.7526	93	121.126372		

Total	11495.6525	95	121.006869		

<u>CO_2 Model No. 8</u>
Parameters: R
Conditions: FF
Command: anova ef rapm if poll==8 & apcd==1, cont(rapm)

Number of obs = 96 R-squared = 0.0024
Root MSE = 11.0457 Adj R-squared = -0.0083

Source	Partial SS	df	MS	F	Prob > F
Model	27.0457727	1	27.0457727	0.22	0.6389
rapm	27.0457727	1	27.0457727	0.22	0.6389
Residual	11468.6068	94	122.006455		
Total	11495.6525	95	121.006869		

<u>CO_2 Model No. 9</u>
Parameters: R, P, R*P
Conditions: VS
Command: anova ef rapm ratem rapm*ratem if poll==8 & apcd==2, cont(rapm ratem)

Number of obs = 30 R-squared = 0.0515
Root MSE = 15.4465 Adj R-squared = -0.0579

Source	Partial SS	df	MS	F	Prob > F
Model	336.985831	3	112.32861	0.47	0.7052
rapm	.626097341	1	.626097341	0.00	0.9595
ratem	53.9158564	1	53.9158564	0.23	0.6385
rapm*ratem	14.6330984	1	14.6330984	0.06	0.8064
Residual	6203.48776	26	238.595683		
Total	6540.47359	29	225.533572		

<u>CO_2 Model No. 10</u>
Parameters: R, P, R*P
Conditions: All data
Command: anova ef rapm ratem rapm*ratem if poll==8, cont(rapm ratem)

Number of obs = 126 R-squared = 0.0146
Root MSE = 12.2874 Adj R-squared = -0.0097

Source	Partial SS	df	MS	F	Prob > F
Model	272.073208	3	90.6910692	0.60	0.6158
rapm	4.55369698	1	4.55369698	0.03	0.8624
ratem	221.601606	1	221.601606	1.47	0.2280
rapm*ratem	36.3960543	1	36.3960543	0.24	0.6243
Residual	18419.5904	122	150.980249		
Total	18691.6636	125	149.533309		

<u>CO_2 Model No. 11</u>
Parameters: R, P
Conditions: All data

Command: anova ef rapm ratem if poll==8, cont(rapm ratem)

```
                     Number of obs =     126     R-squared     =  0.0126
                     Root MSE      = 12.2494     Adj R-squared = -0.0034

          Source |  Partial SS    df       MS           F     Prob > F
      -----------+----------------------------------------------------
           Model |  235.677153     2  117.838577       0.79     0.4582
                 |
            rapm |  104.634483     1  104.634483       0.70     0.4053
           ratem |  190.574533     1  190.574533       1.27     0.2619
                 |
        Residual |  18455.9864   123   150.04867
      -----------+----------------------------------------------------
           Total |  18691.6636   125  149.533309
```

CO_2 Model No. 12
Parameters: R
Conditions: All data
Command: anova ef rapm if poll==8, cont(rapm)

```
                     Number of obs =     126     R-squared     =  0.0024
                     Root MSE      = 12.2628     Adj R-squared = -0.0056

          Source |  Partial SS    df       MS           F     Prob > F
      -----------+----------------------------------------------------
           Model |  45.1026198     1  45.1026198       0.30     0.5849
                 |
            rapm |  45.1026198     1  45.1026198       0.30     0.5849
                 |
        Residual |   18646.561   124  150.375492
      -----------+----------------------------------------------------
           Total |  18691.6636   125  149.533309
```

B.7 NITROGEN OXIDES

B.7.1. Results of t-tests for NO_x

NO_x t-test No. 1
Comparison: Oil-fired vs. gas-fired
Command: ttest ef if poll==9, by(fuel)

```
  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
         1 |        5    .0509889     .023875
         2 |        4    .0285833    .0155953
  ---------+---------------------------------
  combined |        9    .0410309    .0227081

           Ho:  mean(x) = mean(y)  (assuming equal variances)
                     t = 1.61 with 7 d.f.
               Pr > |t| = 0.1513
```

B.7.2. Results of Linear Model Analysis for NO_x

NO_x Model No. 1
Parameters: R, P, R*P
Conditions: All data
Command: anova ef rapm ratem rapm*ratem if poll==9, cont(rapm ratem)

```
                     Number of obs =       5     R-squared     =  0.9713
                     Root MSE      = .009963     Adj R-squared =  0.8852

          Source |  Partial SS    df       MS           F     Prob > F
      -----------+----------------------------------------------------
```

Source	Partial SS	df	MS	F	Prob > F
Model	.003360569	3	.00112019	11.28	0.2146
rapm	.00001419	1	.00001419	0.14	0.7699
ratem	.000108409	1	.000108409	1.09	0.4860
rapm*ratem	5.5843e-07	1	5.5843e-07	0.01	0.9523
Residual	.00009927	1	.00009927		
Total	.003459838	4	.00086496		

NO_x Model No. 2
Parameters: R, P
Conditions: All data
Command: anova ef rapm ratem if poll==9, cont(rapm ratem)

```
Number of obs =       5     R-squared     =  0.9711
Root MSE      = .007065     Adj R-squared =  0.9423
```

Source	Partial SS	df	MS	F	Prob > F
Model	.00336001	2	.001680005	33.66	0.0289
rapm	.001146707	1	.001146707	22.97	0.0409
ratem	.003007868	1	.003007868	60.26	0.0162
Residual	.000099828	2	.000049914		
Total	.003459838	4	.00086496		

Command: regress

Source	SS	df	MS
Model	.00336001	2	.001680005
Residual	.000099828	2	.000049914
Total	.003459838	4	.00086496

```
Number of obs =       5
F(  2,     2) =   33.66
Prob > F      =  0.0289
R-squared     =  0.9711
Adj R-squared =  0.9423
Root MSE      =  .00706
```

efm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	.2705603	.0312612	8.655	0.013	.136054	.4050665
rapm	-.2006977	.0418724	-4.793	0.041	-.3808601	-.0205353
ratem	-.0005937	.0000765	-7.763	0.016	-.0009227	-.0002646

B.8 SULFUR DIOXIDE

B.8.1. Results of t-tests for SO_2

SO_2 t-test No. 1
Comparison: Waste oil-fired vs. non waste oil-fired
Command: ttest ef if poll==10 & wastem<3, by(wastem) unequal

Variable	Obs	Mean	Std. Dev.
1	3	.0914533	.0732035
2	4	.0072046	.0053212
combined	7	.0433112	

```
Ho:  mean(x) = mean(y)   (assuming unequal variances)
           t = 1.99 with 2.02 d.f.
     Pr > |t| = 0.1839
```

SO_2 t-test No. 2
Comparison: Waste oil-fired vs. non waste oil-fired for FF

Command: ttest ef if poll==10 & wastem<3 & apcd==1, by(wastem)

Variable	Obs	Mean	Std. Dev.
1	3	.0914533	.0732035
2	2	.0115833	.0011078
combined	5	.0595053	.067775

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.46 with 3 d.f.
Pr > |t| = 0.2395

SO_2 t-test No. 3
Comparison: Oil-fired vs. gas-fired for FF and RAP
Command: ttest ef if poll==10 & apcd==1 & fuel<3, by(fuel)

Variable	Obs	Mean	Std. Dev.
1	5	.0595053	.067775
2	3	.0033778	.0019087
combined	8	.0384575	.0589042

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.39 with 6 d.f.
Pr > |t| = 0.2143

SO_2 t-test No. 4
Comparison: FF vs. VS for RAP < 0.1
Command: ttest ef if poll==10 & rap<0.1, by(apcd)

Variable	Obs	Mean	Std. Dev.
1	3	.1832733	.3025781
2	4	.0042838	.0035945
combined	7	.0809936	.1991929

Ho: mean(x) = mean(y) (assuming equal variances)
t = 1.22 with 5 d.f.
Pr > |t| = 0.2753

B.8.2. Results of Linear Model Analysis for SO_2

SO_2 Model No. 1
Parameters: R, P, R*P
Conditions: All data
Command: anova ef rapm ratem rapm*ratem if poll==10, cont(rapm ratem)

Number of obs = 12 R-squared = 0.0462
Root MSE = .176267 Adj R-squared = -0.3115

Source	Partial SS	df	MS	F	Prob > F
Model	.01204143	3	.00401381	0.13	0.9401
rapm	.000443648	1	.000443648	0.01	0.9078
ratem	.009606716	1	.009606716	0.31	0.5934
rapm*ratem	.001334126	1	.001334126	0.04	0.8410
Residual	.248559193	8	.031069899		
Total	.260600624	11	.023690966		

SO_2 Model No. 2

Parameters: R, P
Conditions: All data
Command: anova ef rapm ratem if poll==10, cont(rapm ratem)

Number of obs = 12 R-squared = 0.0411
Root MSE = .166631 Adj R-squared = -0.1720

Source	Partial SS	df	MS	F	Prob > F
Model	.010707305	2	.005353652	0.19	0.8280
rapm	.002702477	1	.002702477	0.10	0.7622
ratem	.008510952	1	.008510952	0.31	0.5933
Residual	.249893319	9	.027765924		
Total	.260600624	11	.023690966		

SO_2 Model No. 3
Parameters: R
Conditions: All data
Command: anova ef rapm if poll==10, cont(rapm)

Number of obs = 12 R-squared = 0.0084
Root MSE = .16075 Adj R-squared = -0.0907

Source	Partial SS	df	MS	F	Prob > F
Model	.002196352	1	.002196352	0.08	0.7766
rapm	.002196352	1	.002196352	0.08	0.7766
Residual	.258404272	10	.025840427		
Total	.260600624	11	.023690966		