Emission Factor Documentation for AP-42
Section 9.7

Cotton Ginning

Final Report

For U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Factors and Inventory Group

EPA Contract No. 68-D2-0159
Work Assignment No. 3-01

MRI Project No. 4603-01

June 1996

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For U. S. Environmental Protection Agency
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Research Triangle Park, NC 27711

Attn: Mr. Dallas Safriet (MD-14)

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NOTICE

PREFACE

This report was prepared by Midwest Research Institute (MRI) for the Office of Air Quality Planning and Standards (OAQPS), U. S. Environmental Protection Agency (EPA), under Contract No. 68-D2-0159, Work Assignment No. 3-01. Mr. Dallas Safriet was the requester of the work.

Approved for:

MIDWEST RESEARCH INSTITUTE

Roy Neulicht
Program Manager
Environmental Engineering Department

Jeff Shular
Director, Environmental Engineering
Department

June 1996

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1. INTRODUCTION

The document *Compilation of Air Pollutant Emission 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 is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors usually are expressed as the weight of pollutant divided by the unit weight, volume, distance, or duration of the activity that emits the pollutant. The emission factors presented in AP-42 may be appropriate to use in a number of situations, such as making source-specific emission estimates for areawide inventories for dispersion modeling, developing control strategies, screening sources for compliance purposes, establishing operating permit fees, and making permit applicability determinations. The purpose of this report is to provide background information from test reports and other information to support revisions to AP-42 Section 6.7, Cotton Ginning.

This background report consists of five sections. Section 1 includes the introduction to the report. Section 2 gives a description of the cotton ginning industry. It includes a characterization of the industry, a description of the different process operations, a characterization of emission sources and pollutants emitted, and a description of the technology used to control emissions resulting from these sources. Section 3 is a review of emission data collection (and emission measurement) 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 how the revised AP-42 section was developed. It includes the review of specific data sets, a description of how candidate emission factors were developed, and a summary of changes to the AP-42 section. Section 5 presents the AP-42 Section 9.7, Cotton Ginning. Supporting documentation for the emission factor calculations is presented in the appendices.

2. INDUSTRY DESCRIPTION

Cotton is a natural fiber crop derived from a herbaceous plant of the *Malvaceae* family. The fibers (lint) grow from and are attached to the surface of the seeds, which are located inside a capsule or boll. When mature, the bolls open, exposing the fiber and seed. Raw cotton, called "seed cotton" is then harvested by machine from the fields. The series of mechanical processes for cleaning the seed cotton, separating the fibers from the seeds, and baling the lint cotton is called ginning. Section 2.5 summarizes terminology associated with cotton production and processing.

2.1 INDUSTRY CHARACTERIZATION[1-10]

Cotton ginning (SIC 0724) takes place throughout the southern part of the United States (a region known as the Sunbelt). The four main production regions can be classified as:

- Southeast—Virginia, North Carolina, South Carolina, Georgia, Alabama, and Florida
- Mid-South—Missouri, Tennessee, Mississippi, Arkansas, and Louisiana
- Southwest—Texas and Oklahoma
- West—New Mexico, Arizona, and California

The majority of the ginning facilities are located in Texas, Mississippi, Arkansas, California, and Louisiana.

The industry trend is toward fewer gins with higher processing capacity. In 1979, 2,332 active gins in the United States produced 14,161,000 bales of cotton. By the 1994/1995 season, the number of cotton gins in the United States dropped to 1,306, but about 19,122,000 bales were produced. The average volume processed per gin in 1994/1995 was 14,642 bales, compared with 7,096 bales during the 1989/1990 season.

Cotton ginning is seasonal. It begins with the maturing of the cotton crop, which varies by region, and ends when the crop is finished. Each year the cotton ginning season starts in the lower Southwest Region in midsummer, continues through the South Central and other geographical regions in late summer and early autumn, and ends on the upper Southwest Region in late autumn and early winter. Most of the cotton is ginned between October 1 and December 31. The bulk of the crop from each geographical region is ginned in 6 to 8 weeks. During the remainder of the year, the gin is idle.

Different varieties of cotton are grown, depending on regional conditions. The variety of cotton grown dictates the harvesting method and to a small extent affects the ginning process. All U.S. cotton in commercial production is now harvested by machine; hand picking is no longer practiced. Two types of machines are used: pickers and strippers. Machine-picked cotton normally accounts for 70 to 80 percent of the total cotton harvested, while machine-stripped cotton normally accounts for 20 to 30 percent of the total cotton harvested. Machine picking differs from machine stripping mainly in the method by which the seed cotton is removed from the plant. The spindle picker machine selectively separates the exposed seed cotton from the open bolls or capsules while the mechanical stripper removes the entire capsule with seed cotton plus bract, leaf, and stem components in the harvested material. A field may be picked more than once during harvest. "Second pick cotton" usually has more trash than "first pick." "Ground cotton" may also be picked up from the ground after picking. It has a high waste content.

Stripper-type cotton is a shorter plant than picker-type and is grown in the more arid areas of Texas, Oklahoma, and eastern New Mexico. Fields are stripped only once during harvest. Strippers collect up to six times more leaves, burs, sticks, and trash than the spindle picker machines. Stripper-harvested cotton may produce as much as 1,000 pounds (lb) of trash per 480-lb bale of lint, compared to 150 lb of trash per 480-lb bale from picker-harvested cotton. Early season stripper harvest usually has more green bolls, while late season harvest usually has more trash overall. The higher ratio of trash to cotton resulting from machine-stripping requires gins to have additional equipment for cleaning and trash extraction.

In addition to the types of cotton, cotton fibers are classified as upland or extra long staple. Both types may be grown in the same area. Some facilities may devote separate gins to each type.

The modular system of seed cotton storage and handling has been rapidly adopted. This system stores seed cotton in the field after harvesting until the gin is ready to process it. Modules can also be transported longer distances, allowing gins to increase productivity. In 1994, 78 percent of the U.S. crop was handled in modules.

2.2 PROCESS DESCRIPTION

Typically, modern cotton gins produce 10 to 60 480-lb bales/hour and 1,000 to 80,000 bales/season. Because of the elimination of hand picking, gin operators have installed additional extracting and cleaning machines to maintain quality and grade levels demanded by their mill customers. About 1,500 lb of picker-harvested seed cotton or about 2,400 lb of stripper-harvested seed cotton produce a 480-lb bale of lint cotton. Cotton gins can remove 90 to 99 percent of the trash and all of the seed from the lint.

The modern gin is equipped with many accessories that employ several different physical principles to dry the seed cotton; remove green bolls; separate soil, stick, and capsule components (burs) from seed cotton; remove lint from seed; humidify if necessary; remove plant and soil trash from ginned lint; align and smooth the fibers; and package the fiber into a bale for transport and storage.

A typical cotton ginning facility is divided into five processing areas: unloading system; seed cotton drying and cleaning system; overflow system; ginning and lint cleaning system; and battery condenser and baling system. Each stage is shown in Figure 2-1 and is briefly described below. The first three stages are usually referred to as the high pressure side of the plant, while the last two (lint cleaning through baling) are called the low pressure side, reflecting the pressures used in the air conveying systems.

The proportion of cotton ginning products varies with the nature of the raw cotton, its method of harvest, and the ginning equipment. Moisture content of raw cotton can range as high as 20 percent (before drying) in the humid Southeast to as low as 4 percent in arid areas. Machine-picked seed cotton typically yields about 55 percent cottonseed, 34 percent cotton lint, 1.5 percent cotton motes, and 9.5 percent trash (3.3 percent burs, 4.8 percent leaf and dirt, 1.4 percent sticks). Stripped cotton typically yields about 41 percent cottonseed, 23 percent lint, and 36 percent trash (23.4 percent burs, 7.2 percent leaf and dirt, 5.4 percent sticks).

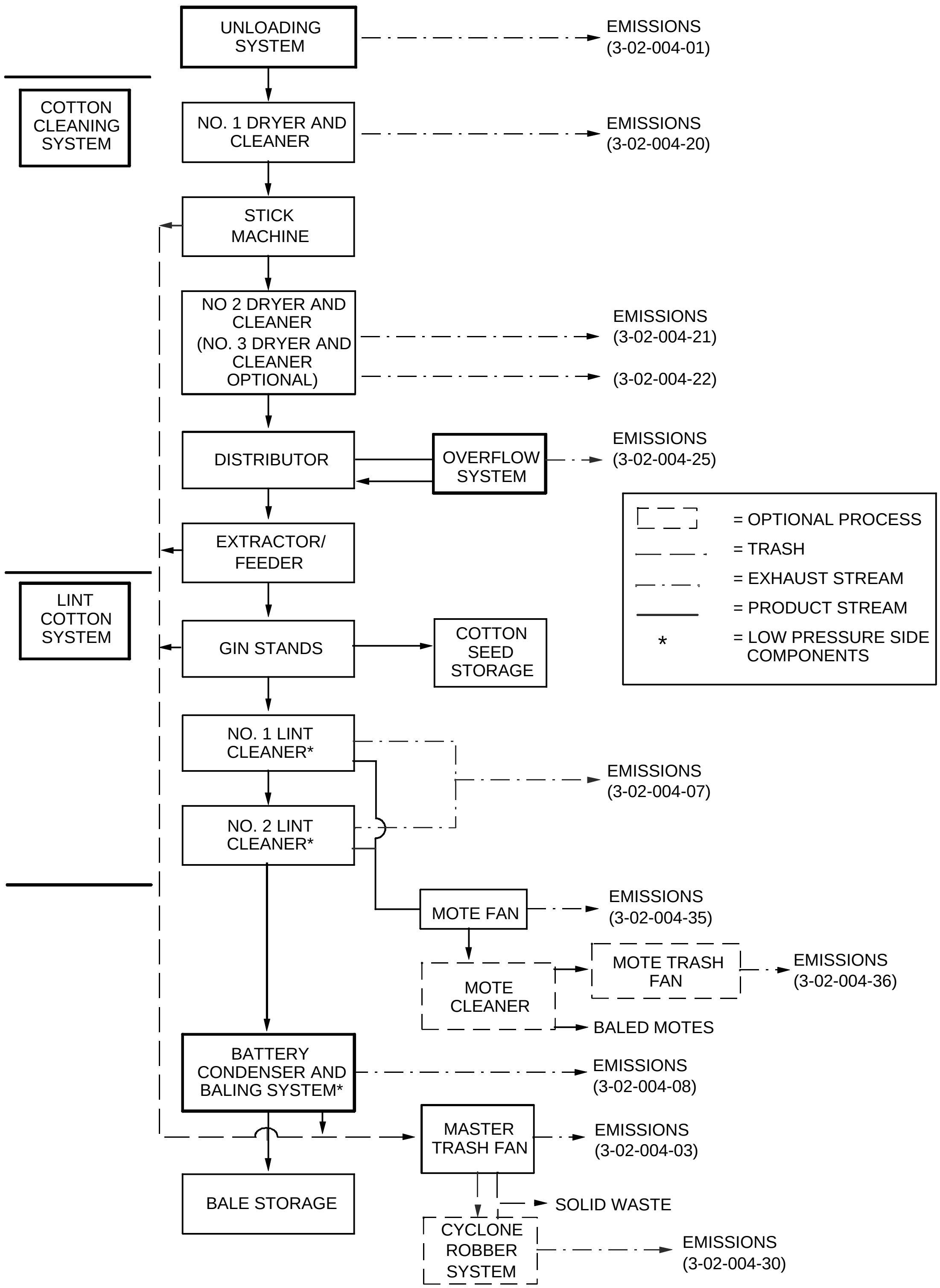

Figure 2-1. Flow diagram of cotton ginning process.
(Source Classification Codes in parentheses.)

2.2.1 Unloading System

2.2.1.1 Unloading System. Module trucks and trailers transport cotton from the field to the gin. A pneumatic system removes the cotton from the trailers, and either a pneumatic system or a module feeder removes the cotton from modules. A combination conveyer and pneumatic system conveys the cotton to a separator and feed control unit. Prior to this first separator point, some gins use a stone and green boll trap for preliminary trash removal. The screen assembly in the separator allows air to escape but collects the cotton and allows it to fall into the feed control unit. The conveying air then flows from the separator to a cyclone system, where it is cleaned and discharged to the atmosphere.

2.2.2 Seed Cotton Cleaning System

Cotton is subjected to three basic conditioning processes--drying, cleaning, and extracting--before it is processed for separation of lint and seed. To ensure adequate conditioning, cotton gins typically use two conditioning systems (drying, cleaning, extracting) in series (see Figure 2-1).

Seed cotton dryers are designed to reduce lint cotton moisture content to 5 to 8 percent to facilitate cleaning and fiber/seed separation. A high-pressure fan conveys seed cotton through the drying system to the first seed cotton cleaner, which loosens the cotton and removes fine particles of foreign matter (e.g., leaf trash, sand, and dirt). In the second cleaner, large pieces (e.g., sticks, stems, and burs) are removed from the cotton by a different process, referred to as "extracting." Different types of extractors may be used, including bur machines, stick machines, stick and bur machines, stick and green leaf extractors, and extractor/feeders. These machines remove burs, sticks, stems, and large leaves, pneumatically conveying them to the trash storage area. The cotton is pneumatically conveyed to the next processing step. Typically, all conveying air is cleaned by a cyclone before being released to the atmosphere.

2.2.3 Overflow System

After cleaning, the cotton enters a screw conveyor distributor, which apportions the cotton to the extractor/feeders at a controlled rate. The extractor/feeders drop the cotton into the gin stands at the recommended processing rates. If the flow of cotton exceeds the limit of the extractor/feeder systems, the excess cotton flows into the overflow hopper. A pneumatic system (overflow separator) then returns this cotton back to the screw conveyor distributor, as required. Typically, the air from this system is routed through a cyclone and cleaned before being exhausted to the atmosphere.

2.2.4 Ginning and Lint Handling System

Cotton enters the gin stand through a "huller front," which performs some cleaning. Saws grasp the locks of cotton and draw them through a widely spaced set of "huller ribs" that strip off hulls and sticks. (New gin stands do not have huller ribs.) The cotton locks are then drawn into the roll box, where fibers are separated from the seeds. After all the fibers are removed, the seeds slide down the face of the ginning ribs and fall to the bottom of the gin stand for subsequent removal to storage. Cotton lint is removed from the saws by a rotating brush, or a blast of air, and is conveyed pneumatically to the lint cleaning system for final cleaning and combing. The lint cotton is removed from the conveying airstream by a condenser that forms the lint into a batt. The lint batt is fed into the first lint cleaner, where saws comb the lint cotton again and remove part of the remaining leaf particles, grass, and motes. Most condensers are covered with fine mesh wire or fine perforated metal, which acts to filter short lint fibers and some dust from the conveying air.

2.2.5 Battery Condenser and Baling System

Lint cotton is pneumatically transported from the lint cleaning system to a battery condenser, which is a drum covered with fine mesh screen or fine perforated metal that separates the lint cotton from the conveying air. The lint cotton is formed into batts and fed into a baling press, which compresses the cotton into uniform bales.

Most gins use a double-press box for packaging the cotton into bales. The lint drops into one press box and fills it while a bale is being pressed and strapped in the other box. Approximately 480 lb (217 kilograms [kg]) of cotton is pressed into a bale before it is wrapped with a cover and strapped. Modern gins are presently equipped with higher-tonnage bale presses that produce the more compact universal density cotton bales. In 1995, 96 percent of the U.S. crop was pressed into universal density bales at the gins. The finished cotton bale is transported to the textile mill for processing into yarn. Motes are sometimes cleaned and baled also.

2.3 EMISSIONS

Particulate matter (PM) is the primary air pollutant emitted from cotton ginning. All processes in a gin involve dust generation from the trash, seeds, and lint cotton. The amount of PM emissions varies depending on the type of gin, geographic region, type of cotton, harvest method, trash content, climate, production rate, and type and number of controls used by the facility. Typically, the air from each step in the process goes through a control device before being vented to the atmosphere.

Cotton fields may be treated with any of several agricultural crop protection chemicals, including fertilizers, pesticides, and harvesting aids (such as defoliants and desiccants). Little information is available on residues of such chemicals on the PM emissions from a cotton gin. The harvesting of cotton can pick up bits of soil, but little information is available on emissions of silica or metallic compounds during cotton ginning. Finally, cotton dryers are fired by gas (or oil), which produces CO_2 and small amounts of combustion by-products, but the extent of drying required varies widely; average emissions are expected to be minimal.

2.4 EMISSION CONTROL TECHNOLOGY[1,7-15]

Cyclones are the principal control for PM emissions on high-pressure airstreams in cotton gins. Properly designed and operated high-efficiency cyclones remove over 99 percent of particulate by weight, and nearly 100 percent of particulate greater than 25 microns (µm). Cyclones operated in series have also proven successful. Two types of cyclones that are used are 2D-2D and 1D-3D cyclones. Both the body and the cone of a 2D-2D cyclone are twice as long as the cyclone diameter. The body of a 1D-3D cyclone is the same length as the diameter, and the cone length is three times the diameter. In many cases, 1D-3D cyclones display slightly higher PM control efficiencies than 2D-2D cyclones.

Skimmers are used as initial control devices with a secondary control device following the skimmer. They may be used on high-pressure systems in place of cyclones or on low-pressure systems. The collection efficiency has been reported at 50 percent removal of PM by weight.

Unifilters handle exhaust from low- and high-pressure systems. Laboratory testing found an average of 99 percent removal of PM by weight. In operation, the unifilters have had performance problems such as clogging and rapid degradation of the filter media.

In-line air filters have been used on low-pressure systems, but are rarely used in today's cotton gins. Past testing indicated the in-line filters had a 75 percent PM removal efficiency.

A condenser drum covering may reduce particulate by about 50 percent in a low-pressure system. By covering the condenser drum with fine metal screen or with perforated metal, large diameter particulate emissions can be effectively eliminated.

Disposal of combustible gin wastes (burs, leaves, stems, sticks, dirt) by open burning or simple teepee incinerators was practiced by over 35 percent of the gins before 1970, but all waste incineration has been eliminated by pollution control regulations. Today, most gin waste is removed from the gin site and spread on farm land as a soil additive.

2.5 SUMMARY OF TERMINOLOGY

Bale — A compressed and bound package of cotton lint, typically weighing about 480 lb.

Batt — Matted lint cotton.

Boll — The capsule or pod of the cotton plant.

Bur (or burr) — The rough casing of the boll. Often referred to as hulls after separation from the cotton.

Condenser — A perforated or screened drum device designed to collect lint cotton from the conveying airstream, at times into a batt.

Cotton — General term used variously to refer to the cotton plant (genus *Gossypium*); agricultural crop; harvest product; white fibers (lint) ginned (separated) from the seed; baled produce; and yarn or fabric products. Cotton is classified as upland or extra long staple depending on fiber length.

Cottonseed — The seed of the cotton plant, separated from its fibers. The seeds constitute 40 percent to 55 percent of the seed cotton (depending on the amount of trash) and are processed into oil meal, linters, and hulls, or are fed directly to cattle.

Cyclone — A centrifugal air pollution control device for separating solid particles from an airstream.

Cyclone robber system - A secondary cyclone trash handling system. These systems are not used at most cotton gins.

Cylinder cleaner — A machine with rotating spiked drums that open the locks and clean the cotton by removing dirt and small trash.

Extractor — Equipment for removing large trash pieces (sticks, stems, burs, and leaves). The equipment may include one or more devices, including a stick machine, bur machine, green-leaf machine, and a combination machine.

Extractor-feeder — A device that gives seed cotton a final light extraction/cleaning and then feeds it at a controlled rate to the gin stand.

Fly lint (or lint fly) — Short (less than 50 µm) cotton fibers, usually emitted from condensers and mote fan.

Gin stand — The heart of the ginning plant where gin saws (usually several in parallel) separate the cotton lint from the seeds.

High pressure side — The portion of the process preceding the gin stand (including unloading, drying, extracting, cleaning, and overflow handling systems) in which material is conveyed by a higher pressure air, and exhausts are typically controlled by cyclones.

In-line filter — A screen device with wiping brush or arm that removes fly lint and dust from conveying air before the air is discharged to the atmosphere.

Lint cleaner — A machine for removing foreign material from lint cotton.

Lint cotton — Cotton fibers from which the trash and seeds have been removed by the gin.

Low pressure side — The portion of the process following the gin stand (including lint cotton cleaning and batt formation process) in which material is conveyed by low pressure air, and exhausts are typically controlled by condensers.

Mote — A small group of short fibers attached to a piece of the seed or to an immature seed. Motes may be cleaned and baled.

Picker harvester — A machine that removes cotton lint and seeds from open bolls with rotating spindles, leaving unopened bolls on the plant. "First pick" cotton is obtained from the initial harvest of the season. It usually contains less trash than "second pick" cotton, obtained later in the harvest season. "Ground cotton" is obtained by picking up between the rows at season's end and has a high trash content.

Seed cotton — Raw cotton, containing lint, seed, and some waste material, as it comes from the field.

Separator — A mechanical device (e.g., wire screen with rotary rake) that separates seed cotton from conveying air.

Skimmer — A curved air pollution control device that can separate part of the waste (leaves, dust, fly lint) from an airstream by centrifugal force. The skimmed (dirty) air is cleaned (e.g., cyclone filter) before discharge while the main airstream can be discharged.

Stripper harvester — A machine that strips all bolls — opened (mature) and unopened (immature or green) — from the plant; strippers are used on short cotton plants, grown in arid areas of Texas, Oklahoma, and New Mexico. They collect larger amounts of trash (leaves, stems, and sticks) than picker harvesters.

REFERENCES FOR SECTION 2

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2. *Control Technology Assessment of Raw Cotton Processing Operations*, Enviro Control Inc. Prepared for the National Institute for Occupational Safety and Health, Cincinnati, OH, June 15, 1980.

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14. Oliver L. McCaskill and Richard A. Wesley, *Tests Conducted on Exhausts of Gins Handling Machine Picked Cotton*, The Cotton Gin and Oil Mill Press, September 5, 1970, pp. 7-9.

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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), Crosswalk/Air Toxic Emission Factor Data Base Management System (XATEF), and VOC/PM Speciation Data Base Management System (SPECIATE) data bases were searched by SCC code 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 USDA Economic Research Service 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 cotton ginning industry. Copies of these test reports were obtained from the files of the Emissions, Monitoring, and Analysis Division (EMAD). The EPA library was searched for additional test reports. Using information obtained on plant locations, 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) were also searched for reports on emissions from the cotton ginning industry. In addition, representative trade associations, including the National Cotton Council of America, 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 were generally 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 DATA QUALITY RATING SYSTEM[1]

As part of the analysis of the emission data, 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 (i.e., comparison of EPA Method 5 front half with 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.

Test data sets that were not excluded were assigned a quality rating. The rating system used was that specified by EFIG for preparing AP-42 sections. The data were rated as follows:

A — Multiple tests that were 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 EPA reference test methods, although these methods were 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. Source operation. 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. Sampling procedures. 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. Sampling and process data. Adequate sampling and process data are documented in the report, and any variations in the sampling and process operation are noted. If a large spread between test results

cannot be explained by information contained in the test report, the data are suspect and are 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 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[1]

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

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

B—Above average: Developed only from A- or B-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 industries. The source category is specific enough so that variability within the source category population may be minimized.

C—Average: Developed only from A-, B- and/or 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. In addition, 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 only from A-, B-, and/or 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 footnoted.

The use of these criteria is somewhat subjective and depends to an extent upon the individual reviewer. Details of the rating of each candidate emission factor are provided in Section 4.

REFERENCE FOR SECTION 3

1. *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections,* EPA-454/B-93-050, Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1993.

4. REVIEW OF SPECIFIC DATA SETS

4.1 INTRODUCTION

This section describes how the revised AP-42 section on cotton ginning was developed. First, descriptions of data sets reviewed for this revision are presented, followed by a discussion of how candidate emission factors were developed from the data. Finally, the proposed changes to the existing AP-42 section on cotton ginning are summarized.

4.2 REVIEW OF SPECIFIC DATA SETS

Fourteen new references were obtained and reviewed for use in developing emission factors from cotton ginning operations, and two references from the existing background file were also used. These sixteen references are described in Sections 4.2.1 through 4.2.16 of this report. References 17 through 19 were used for background information, but do not contain any emission data.

4.2.1 Reference 1

This report documents the results of an emission test conducted at Westfield Gin in Riverdale, California on November 14 and 15, 1991. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a main trash stockpiler cyclone, a No. 2 incline cleaner cyclone, and a gin feed trash cyclone were quantified using CARB Method 5 and a cascade impactor for particle sizing. The main trash stockpiler was equipped with cyclones, but the number and size of the cyclones is not known. Each of the other two sources were equipped with two 38-inch 2D-2D cyclones. To determine the total emissions from the No. 2 incline cleaner and the gin feed trash fan, the measured emissions were doubled because only one of two cyclones controlling each process was tested. Three test runs were conducted on each source, and run-by-run production rates in bales per hour were provided for each test. A description of the facility is not included in the report, but was obtained from San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) personnel.

The total PM data for the No. 2 incline cleaner and the gin feed trash fan are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A, which is similar to the method used, requires that a constant flow rate through the sizing device be maintained during testing). The data for the main trash stockpiler cyclone are not rated and are not used for emission factor development because the process configuration is not known. Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix A contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.2 Reference 2

This report documents the results of an emission test conducted at Airways Gins in Fresno, California, on November 21 and 22, 1991. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a mote trash cyclone, a No. 3 incline cleaner cyclone, and an overflow separator cyclone were quantified using CARB Method 5 and a cascade impactor for particle sizing. The mote trash system was equipped with a single 20 inch 1D-3D cyclone, and each of the other two processes was equipped with dual 40 inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and run-by-run production rates in bales per hour were provided for each test. A description of the facility is not included in the report, but was obtained from SJVUAPCD personnel.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix B contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.3 Reference 3

This report documents the results of an emission test conducted at Mount Whitney Cotton Gin in California on November 29 and 30, 1990. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a cyclone controlling the west plenum (unloading, dryers, and cleaners), a cyclone controlling the east plenum (overflow separator and main trash fans), a mote cyclone, and a mote condenser cyclone (assumed similar to mote trash fans at other facilities) were measured using CARB Method 5 and a cascade impactor for particle sizing. Based on the magnitude of emissions and a note in the report that states that the test was conducted prior to 1991 modifications, the cyclones tested are assumed to be 2D-2D cyclones. The documentation includes a note that this test was performed prior to control system modifications, and several other reports discuss similar plants that switched from 2D-2D to 1D-3D cyclones at around the same time. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source (15 cyclones controlling the unloading, drying, and cleaning operations; 4 overflow separator/main trash cyclones; 2 mote cyclones; and 1 mote trash cyclone). These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Two test runs were conducted on each source. Process rates and a description of the processes tested are not included in the report, but were obtained from SJVUAPCD personnel.

The total PM data are assigned a B rating because only two test runs were performed. The PM-10 data are assigned a B rating because only two test runs were performed and flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix C contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.4 Reference 4

This report documents the results of an emission test conducted at Stratford Growers in California on November 27 and 28, 1990. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a trash cyclone, a No. 1 dryer and cleaner cyclone, a No. 2 dryer and cleaner cyclone, and a mote cyclone were quantified using CARB Method 5 and a cascade impactor for particle sizing. Based on the magnitude of emissions and a note in the report that states that the test was conducted prior to 1991 modifications, the cyclones tested are assumed to be 2D-2D cyclones. The documentation includes a note that this test was performed prior to control system modifications, and several other similar plants switched from 2D-2D to 1D-3D cyclones at around the same time. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source (two trash cyclones, four No. 1 dryer and cleaner cyclones, four No. 2 dryer and cleaner cyclones, and six mote cyclones). These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Two test runs were conducted on each source, and production rates in bales per hour were provided for each test. A description of the facility is not included in the report, but was obtained from SJVUAPCD personnel.

The total PM data are assigned a B rating because only two test runs were performed. The PM-10 data are assigned a B rating because only two test runs were performed and flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix D contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.5 Reference 5

This report documents the results of an emission test conducted at County Line Gin in Hanford, California, on December 3 and 4, 1990. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a mote cyclone, a lint trap (cleaner) cyclone, a suction cyclone, and a No. 1 dryer cyclone were quantified using CARB Method 5 and a cascade impactor. The mote system was equipped with two 60-inch 2D-2D cyclones, the lint cleaners were equipped with sixteen 38-inch 2D-2D cyclones, the unloading system was equipped with four 34-inch 2D-2D cyclones, and the No. 1 dryer and cleaner was equipped with six 38-inch 2D-2D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Two test runs were conducted on each source, and production rates in bales per hour were provided for each test. A description of the processes tested is not included in the report, but was obtained from SJVUAPCD personnel.

The total PM data are assigned an B rating because only two test runs were conducted. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix E contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.6 Reference 6

This report documents the results of an emission test conducted at County Line Gin in Hanford, California on December 8-11, 1991. The gin processes picker-harvested cotton. The facility is the same facility discussed in Reference 5, but modifications were made to the PM control system following the Reference 5 test and before this test program was conducted. Total PM and PM-10 emissions from a mote cyclone, a lint cleaner cyclone, a suction cyclone, an overflow cyclone, a No. 1 dryer cyclone, a No. 2 dryer cyclone, a gin stand trash cyclone, and a battery condenser cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The mote system was equipped with four 44-inch 1D-3D cyclones, the unloading system was equipped with three 46-inch 1D-3D cyclones, the lint cleaners were equipped with eight 48-inch 1D-3D cyclones, the overflow separator was equipped with a single 40-inch 1D-3D cyclone, the No. 1 dryer and cleaner was equipped with four 41-inch 1D-3D cyclones, the gin stand trash system was equipped with two 38-inch 1D-3D cyclones, the battery condenser was equipped with four 49-inch 1D-3D cyclones, and the No. 2 dryer and cleaner was equipped with four 40-inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix F contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.7 Reference 7

This report documents the results of an emission test conducted at Westfield Gin in Riverdale, California, on November 12, 1992. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a main trash cyclone (a 38-inch 1D-3D cyclone) were quantified using CARB Methods 5 and 501 (cascade impactor). To calculate the total emission rate from the source, the measured emission rate was multiplied by the number of cyclones used to control emissions from the source (two main trash cyclones). This total emission rate is based on the assumption that the emissions are the same from both cyclones controlling the process. Three test runs were conducted, and run-by run production rates in bales per hour were provided.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix G contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.8 Reference 8

This report documents the results of an emission test conducted at West Valley Cotton Growers in Riverdale, California, on October 28, 1993. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a battery condenser cyclone and a No. 3 dryer cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The battery condenser was equipped with one 80-inch 1D-3D cyclone, and the No. 3 dryer and cleaner was equipped with three 38-inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and run-by-run production rates in bales per hour were provided for each test.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix H contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.9 Reference 9

This report documents the results of an emission test conducted at Dos Palos Cooperative Gin in Dos Palos, California, on November 27-29, 1992. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a mote cyclone, a lint cleaner cyclone, an unloading cyclone, an overflow cyclone, a No. 1 dryer cyclone, a No. 2 dryer cyclone, and a battery condenser cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The mote system was equipped with four 42-inch 1D-3D cyclones, the lint cleaners were equipped with six 48-inch 1D-3D cyclones, the unloading system was equipped with three 46-inch 1D-3D cyclones, the overflow separator was equipped with one 36-inch 1D-3D cyclone, the No. 1 dryer and cleaner was equipped with two 50-inch 1D-3D cyclones, the No. 2 dryer and cleaner was equipped with two 50-inch 1D-3D cyclones, and the battery condenser was equipped with four 48-inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix I contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.10 Reference 10

This report documents the results of an emission test conducted at Halls Gin in Halls, Tennessee, on October 25-27, 1988. Testing was conducted during processing of the first harvest of picker-harvested cotton. Filterable PM emissions were measured at all of the ducted emission points at the facility. These emission points include four suction cyclones, four No. 1 dryer (inclined cleaner) cyclones, four No. 2 dryer (inclined cleaner) cyclones, two overflow cyclones, two mote trash cyclones, two cotton waste disposal cyclones, three mote press cyclones, the battery condenser vent (controlled by 80 mesh screening), three ducts venting emission from three first- and second-stage lint cleaners (controlled by perforated drums), and three ducts venting emission from three third-stage lint cleaners (controlled by 80 mesh screening). All of the cyclones tested are 2D-2D cyclones, which have a 2:1 ratio of cone length to cyclone diameter and a 2:1 ratio of body length to cyclone diameter. Rader hi-volume samplers were used to measure PM emissions from these sources. Stack volumetric flow rates were estimated using fan specifications, and were corrected to dry standard conditions. These flow rates were not checked using a velocity traverse or other method, and represent a theoretical flow rather than an actual measurement. Also, the presence of cyclonic flow was not discussed in the report, and could potentially bias the samples taken at the cyclone outlets. The exhaust stream moisture contents were determined by taking the dry and wet bulb temperatures at each exhaust location and reading the corresponding moisture content from a psychrometric chart provided in the report. Three samples were taken at each source, and production rates in bales per hour were provided for each day of testing.

The data from this report are assigned a D rating because of the limitations in the accuracy of the flow rates and the potential biases from cyclonic flow discussed above. Appendix J contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.11 Reference 11

This report documents the results of EPA-sponsored emission testing conducted at Marana Gin in Marana, Arizona, on November 2-19, 1977. One of the two gins tested processed short-staple picker-harvested cotton, and the other gin processed long-staple picker-harvested cotton. For the gin processing long-staple cotton, total PM emissions from the unloading fan, No. 1 dryer and cleaner, No. 2 dryer and cleaner, master trash fan, and mote system controlled with high-efficiency cyclones were quantified using EPA Method 5. Total PM emissions from the lint cleaners and battery condenser were controlled by screen cages and were quantified using Rader high-vol samplers (similar to the Reference 10 test procedure). For the gin processing short-staple cotton, total PM emissions from the unloading fan, No. 1 dryer and cleaner, No. 2 dryer and cleaner, second stage seed cotton cleaning, master trash fan, and gin stand feeder trash fan controlled with high-efficiency cyclones were quantified using EPA Method 5. Total PM emissions from the lint cleaners and battery condenser were controlled by screen cages and were quantified using Rader high-vol samplers (similar to the Reference 10 test procedure). Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The data for all of the sources except the unloading fan (long-staple cotton), the lint cleaners, and battery condenser are assigned an A rating. The test methodology appeared to be sound, and no problems were reported during testing. The data for the unloading fan (long-staple cotton) are assigned a B rating because only two valid test runs were performed. The data for the lint cleaners and battery condenser are assigned a D rating because the isokinetic sampling rates were greater than 300 percent for most of the test runs, which should bias the emission rates low. Appendix K contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.12 Reference 12

This report documents the results of EPA-sponsored emission testing conducted at Westside Farmers Cooperative Gin No. 5 in Tranquility, California, on November 15-22, 1977. The gin processed picker-harvested cotton. Total PM emissions from the unloading fan, Nos. 1 and 2 dryers and gin stand trash, Nos. 1 and 2 seed cotton cleaners, mote system (combined), and mote cleaner controlled with high-efficiency cyclones were quantified using EPA Method 5 (and a high volume sampler for comparison purposes). Total PM emissions from the first and second stage lint cleaners and battery condenser controlled with screen cages were also quantified using EPA Method 5. Three test runs were conducted on each source, and an average production rate was provided for the entire test period.

The data for all of the sources except the mote cleaner, lint cleaners, and battery condenser are assigned a B rating because only an average process rate was provided in the report. The test methodology appeared to be sound, and no problems were reported during testing. The data for the mote cleaner are assigned a D rating because none of the test runs were within the isokinetic limits specified by Method 5, and the data for the lint cleaners and battery condenser are assigned a C rating because the stack extensions were shorter than required and may have caused a negative bias. Appendix L contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.13 Reference 13

This report documents the results of an emission test conducted at Elbow Enterprises in Visalia, California, on November 7-8, 1994. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a No. 1 dryer and cleaner cyclone and a lint cleaner cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The No. 1 dryer and cleaner was equipped with three high-efficiency cyclones and the lint cleaner was equipped with twelve high-efficiency cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix M contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.14 Reference 14

This report documents the results of an emission test conducted at Stratford Growers in Stratford, California, on October 26-28, 1994. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a lint cleaner cyclone, unloading cyclone, master trash cyclone, mote trash cyclone, cyclone robber system, and feeder trash cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The lint cleaners were equipped with six 56-inch 1D-3D cyclones, the unloading system was equipped with three 42-inch 1D-3D cyclones, the master trash fan was equipped with one 48-inch 1D-3D cyclone, the mote trash fan was equipped with one 28-inch 1D-3D cyclone, the cyclone robber system was equipped with two 1D-3D cyclones, and the feeder trash fan was equipped with one 40-inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test run.

The data used for emission factor development are, in some cases, slightly different from the data presented in the report. This is a result of a calculation error in the report. Specifically, in the calculation of the total PM weight, a negative value was reported for the impinger catch in several test runs. In the report, this negative value was used to reduce the total PM value. For purposes of emission factor development, MRI treated these negative weights as zero rather than including the negative value.

The total PM data are assigned an A rating, except for the data for the mote trash fan, which are assigned a B rating because one of the test runs did not meet the isokinetic requirements. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Also, the PM-10 tests on the lint cleaner and the mote trash fan included only two valid test runs. Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix O contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.15 Reference 15

This report documents the results of an emission test conducted at Alta Vista Gin in Mendota, California, on November 3-4, 1994. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from a battery condenser cyclone, a mote cyclone, and a lint cleaner cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The battery condenser was equipped with two 42-inch 1D-3D cyclones, the mote system was equipped with three 42-inch 1D-3D cyclones, and the lint cleaner was equipped with six 56-inch 1D-3D cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The data used for emission factor development are, in some cases, slightly different from the data presented in the report. This is a result of a calculation error in the report. Specifically, in the calculation of the total PM weight, a negative value was reported for the impinger catch in several test runs. In the report, this negative value was used to reduce the total PM value. For purposes of emission factor development, MRI treated these negative weights as zero rather than including the negative value.

The total PM data are assigned an A rating. The PM-10 data for the battery condenser and lint cleaner are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). The PM-10 data for the mote system are assigned a D rating because the isokinetic requirements of Method 201A (±20 percent) were not met during two of three test runs. Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix O contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.16 Reference 16

This report documents the results of an emission test conducted at Dos Palos Cooperative Gin in Dos Palos, California, on October 31 through November 2, 1994. This test was performed at the same facility as the test documented in Reference 9. However, the control device configuration was modified prior to this test. The gin processes picker-harvested cotton. Total PM and PM-10 emissions from an unloading cyclone, an overflow cyclone, a mote cyclone, a No. 2 dryer cyclone, and a battery condenser cyclone were quantified using CARB Methods 5 and 501 (cascade impactor). The unloading system was equipped with four high-efficiency cyclones, the overflow system was equipped with two high-efficiency cyclones, the mote system was equipped with four high-efficiency cyclones, the No. 2 dryer and cleaner was equipped with four high-efficiency cyclones, and the battery condenser was equipped with four high-efficiency cyclones. To calculate total emission rates from each source, the measured emission rates were multiplied by the number of cyclones used to control emissions from each source. These total emission rates are based on the assumption that the emissions are the same from all cyclones controlling a particular process. Three test runs were conducted on each source, and production rates in bales per hour were provided for each test.

The data used for emission factor development are, in some cases, slightly different from the data presented in the report. This is a result of a calculation error in the report. Specifically, in the calculation of the total PM weight, a negative value was reported for the impinger catch in several test runs. In the report, this negative value was used to reduce the total PM value. For purposes of emission factor development, MRI treated these negative weights as zero rather than including the negative value.

The total PM data are assigned an A rating. The PM-10 data are assigned a B rating because flowrates were adjusted during the test runs to maintain isokinetic sampling (EPA Method 201A requires that a constant flow rate through the sizing device be maintained during testing). Otherwise, the test methodology appeared to be sound, and no problems were reported during testing. Appendix P contains copies of report excerpts, raw data sheets, and emission factor calculations.

4.2.17 Review of FIRE and SPECIATE Data Base Emission Factors

The PM emission factors provided in FIRE are the same factors that are presented in the Cotton Ginning section of the 1977 version of AP-42. The PM-10 emission factors in FIRE are based on the PM emission factors from the 1977 version of AP-42. Several emission factors for arsenic emissions are also included in FIRE, but there is a lack of supporting documentation for these factors. No new data were found in SPECIATE.

4.2.18 Review of Test Data in AP-42 Background File

The test data in the background file are from emission tests conducted before 1978, and most of the tests were conducted before 1972. Two of the test reports are described in Section 4.2.11 and 4.2.12 of this report. Two other references in the background file entitled "Particulate Emissions from Commercial Cotton Ginning Operations" and "Particulate Emissions of a Cotton Gin in the Texas Stripper Area" contain emission data, but do not provide sufficient background documentation of the emission tests. In addition, the test method used in these reports was not an EPA reference method and may not be comparable to other available data. Therefore, data from these two references were not used for emission factor development. The other data in the background file are no longer used for emission factor development because they are not fully documented and are outdated. Although no new uncontrolled emission data are available, the uncontrolled emission factors previously tabulated in AP-42 are based on testing conducted in 1960 at a pilot plant that does not resemble modern operations. In addition, the accuracy of the test method used to quantify PM emissions is unknown. Therefore, the data for uncontrolled operations are not considered representative of the industry and are not included in the revised AP-42 section.

4.3 DEVELOPMENT OF CANDIDATE EMISSION FACTORS

Emission factors were developed by grouping the data from similar combinations of source, pollutant, and control device, discarding the inferior data sets, and averaging the emission factors derived from each data set. In some cases, data were available from multiple tests on the same source. In such cases, the emission factors from the tests on that source were averaged first, and the resulting factor was then averaged with the factors from other similar sources. Table 4-1 presents the available emission data from References 1 through 16. Table 4-2 shows how the data were combined to develop candidate emission factors. Table 4-3 presents the candidate emission factors that are included in the revised AP-42 section.

TABLE 4-1. SUMMARY OF TEST DATA FOR COTTON GINNING[a]

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
No. 2 dryer and cleaner	Total PM	3	A	0.087-0.11 (0.19-0.25)	0.10 (0.22)	1
No. 2 dryer and cleaner	PM-10	3	B	0.025-0.058 (0.054-0.13)	0.042 (0.093)	1
Gin feed trash fan	Total PM	3	A	0.028-0.035 (0.062-0.077)	0.031 (0.068)	1
Gin feed trash fan	PM-10	3	B	0.017-0.020 (0.037-0.043)	0.018 (0.040)	1
Mote trash fan	Total PM	3	A	0.026-0.035 (0.058-0.076)	0.031 (0.067)	2
Mote trash fan	PM-10	3	B	0.014-0.024 (0.031-0.053)	0.018 (0.040)	2
No. 3 dryer and cleaner	Total PM	3	A	0.040-0.043 (0.088-0.095)	0.041 (0.091)	2
No. 3 dryer and cleaner	PM-10	3	B	0.011-0.017 (0.025-0.038)	0.014 (0.030)	2
Overflow fan	Total PM	3	A	0.030-0.056 (0.065-0.012)	0.046 (0.10)	2
Overflow fan	PM-10	3	B	0.012-0.019 (0.026-0.041)	0.016 (0.036)	2
Unloading fan and dryers and cleaners	Total PM	2	B	1.2-2.1 (2.6-4.7)	1.6 (3.6)	3
Unloading fan and dryers and cleaners	PM-10	2	B	0.60-1.0 (1.3-2.3)	0.82 (1.8)	3
Overflow fan and master trash fan	Total PM	2	B	0.34-0.56 (0.74-1.2)	0.45 (0.99)	3
Overflow fan and master trash fan	PM-10	2	B	0.020-0.063 (0.045-0.14)	0.042 (0.092)	3
Mote fan	Total PM	2	B	0.026-0.16 (0.056-0.36)	0.095 (0.21)	3
Mote fan	PM-10	2	B	0.0047-0.076 (0.010-0.17)	0.040 (0.089)	3
Mote trash fan	Total PM	2	B	0.037-0.064 (0.082-0.14)	0.051 (0.11)	3
Mote trash fan	PM-10	2	B	0.0015-0.0027 (0.0033-0.0059)	0.0021 (0.0046)	3
Gin stand trash fan	Total PM	2	B	0.098-0.12 (0.22-0.26)	0.11 (0.24)	4
Gin stand trash fan	PM-10	2	B	0.016-0.055 (0.036-0.12)	0.036 (0.079)	4
No. 1 dryer and cleaner	Total PM	2	B	0.089-0.19 (0.20-0.41)	0.14 (0.30)	4
No. 1 dryer and cleaner	PM-10	2	B	0.028-0.070 (0.062-0.15)	0.049 (0.11)	4
No. 2 dryer and cleaner	Total PM	2	B	0.35-0.36 (0.78-0.79)	0.36 (0.79)	4
No. 2 dryer and cleaner	PM-10	2	B	0.065-0.15 (0.14-0.32)	0.11 (0.23)	4

TABLE 4-1. (continued)

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
Mote fan	Total PM	2	B	0.043-0.054 (0.095-0.12)	0.049 (0.11)	4
Mote fan	PM-10	2	B	0.014-0.032 (0.030-0.070)	0.023 (0.050)	4
Mote fan	Total PM	2	B	0.21-0.74 (0.45-1.6)	0.47 (1.0)	5
Mote fan	PM-10	2	B	0.050-0.23 (0.11-0.50)	0.14 (0.30)	5
Lint cleaners	Total PM	2	B	0.91-1.1 (2.0-2.5)	1.0 (2.3)	5
Lint cleaners	PM-10	2	B	0.32-0.52 (0.71-1.2)	0.42 (0.93)	5
Unloading fan	Total PM	2	B	0.095-0.10 (0.21-0.23)	0.10 (0.22)	5
Unloading fan	PM-10	2	B	0.095-0.10 (0.21-0.23)	0.10 (0.22)	5
No. 1 dryer and cleaner	Total PM	2	B	0.15-0.35 (0.32-0.77)	0.25 (0.54)	5
No. 1 dryer and cleaner	PM-10	2	B	0.061-0.13 (0.13-0.29)	0.096 (0.21)	5
Mote fan	Total PM	3	A	0.14-0.16 (0.30-0.35)	0.15 (0.33)	6
Mote fan	PM-10	3	B	0.071-0.084 (0.16-0.19)	0.079 (0.17)	6
Unloading fan	Total PM	3	A	0.10-0.17 (0.23-0.37)	0.14 (0.30)	6
Unloading fan	PM-10	3	B	0.056-0.082 (0.12-0.18)	0.069 (0.15)	6
Lint cleaners	Total PM	3	A	0.11-0.18 (0.24-0.39)	0.13 (0.29)	6
Lint cleaners	PM-10	3	B	0.057-0.10 (0.13-0.22)	0.072 (0.16)	6
Overflow fan	Total PM	3	A	0.019-0.021 (0.041-0.046)	0.020 (0.044)	6
Overflow fan	PM-10	3	B	0.011-0.014 (0.023-0.031)	0.012 (0.027)	6
No. 1 dryer and cleaner	Total PM	3	A	0.076-0.15 (0.17-0.32)	0.11 (0.24)	6
No. 1 dryer and cleaner	PM-10	3	B	0.025-0.079 (0.056-0.17)	0.050 (0.11)	6
Gin stand trash fan	Total PM	3	A	0.091-0.14 (0.20-0.30)	0.11 (0.23)	6
Gin stand trash fan	PM-10	3	B	0.036-0.051 (0.079-0.11)	0.042 (0.093)	6
Battery condenser	Total PM	3	A	0.018-0.059 (0.040-0.13)	0.037 (0.082)	6

TABLE 4-1. (continued)

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
Battery condenser	PM-10	3	B	0.0035-0.0072 (0.0077-0.016)	0.0058 (0.013)	6
No. 2 dryer and cleaner	Total PM	3	A	0.044-0.052 (0.096-0.12)	0.047 (0.10)	6
No. 2 dryer and cleaner	PM-10	3	B	0.022-0.025 (0.048-0.055)	0.024 (0.053)	6
Master trash fan	Total PM	3	A	0.17-0.20 (0.38-0.43)	0.18 (0.40)	7
Master trash fan	PM-10	3	B	0.045-0.059 (0.10-0.13)	0.051 (0.11)	7
Battery condenser	Total PM	3	A	0.016-0.024 (0.035-0.053)	0.019 (0.042)	8
Battery condenser	PM-10	3	B	0.0039-0.011 (0.0085-0.023)	0.0077 (0.017)	8
No. 3 dryer and cleaner	Total PM	3	A	0.032-0.063 (0.072-0.14)	0.045 (0.099)	8
No. 3 dryer and cleaner	PM-10	3	B	0.011-0.022 (0.024-0.050)	0.016 (0.035)	8
Mote fan	Total PM	3	A	0.064-0.086 (0.14-0.19)	0.076 (0.17)	9
Mote fan	PM-10	3	B	0.045-0.052 (0.099-0.11)	0.048 (0.11)	9
Battery condenser	Total PM	3	A	0.013-0.019 (0.029-0.041)	0.016 (0.036)	9
Battery condenser	PM-10	3	B	0.011-0.012 (0.023-0.027)	0.011 (0.025)	9
Overflow fan	Total PM	3	A	0.0032-0.0063 (0.0070-0.014)	0.0050 (0.011)	9
Overflow fan	PM-10	3	B	0.0010-0.0027 (0.0023-0.0059)	0.0020 (0.0045)	9
Lint cleaners	Total PM	3	A	0.051-0.070 (0.11-0.15)	0.057 (0.13)	9
Lint cleaners	PM-10	3	B	0.025-0.032 (0.055-0.071)	0.028 (0.062)	9
No. 1 dryer and cleaner	Total PM	3	A	0.16-0.19 (0.36-0.42)	0.18 (0.39)	9
No. 1 dryer and cleaner	PM-10	3	B	0.036-0.044 (0.079-0.098)	0.040 (0.089)	9
Unloading fan	Total PM	3	A	0.029-0.050 (0.063-0.11)	0.041 (0.090)	9
Unloading fan	PM-10	3	B	0.020-0.028 (0.044-0.062)	0.024 (0.053)	9
No. 2 dryer and cleaner	Total PM	3	A	0.080-0.11 (0.18-0.24)	0.093 (0.21)	9
No. 2 dryer and cleaner	PM-10	3	B	0.0090-0.032 (0.020-0.071)	0.022 (0.048)	9

TABLE 4-1. (continued)

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
Unloading fan[b]	Total PM	3	D	0.0074-0.0082 (0.016-0.018)	0.0078 (0.017)	10
No. 1 dryer and cleaner[b]	Total PM	3	D	0.022-0.033 (0.049-0.073)	0.027 (0.059)	10
No. 2 dryer and cleaner[b]	Total PM	3	D	0.016-0.018 (0.035-0.039)	0.017 (0.037)	10
Overflow fan[b]	Total PM	3	D	0.012-0.014 (0.027-0.031)	0.013 (0.029)	10
Mote trash fan[b]	Total PM	3	D	0.019-0.023 (0.041-0.050)	0.020 (0.045)	10
Main trash fan[b]	Total PM	3	D	0.028-0.037 (0.062-0.082)	0.033 (0.073)	10
Mote fan[b]	Total PM	3	D	0.029-0.034 (0.063-0.075)	0.032 (0.070)	10
Battery condenser with 80-mesh screens[b]	Total PM	3	D	0.0050-0.0074 (0.011-0.016)	0.0059 (0.013)	10
First and second stage lint cleaners with 16D perforated drums[b]	Total PM	3	D	0.13-0.15 (0.28-0.34)	0.14 (0.30)	10
Third stage lint cleaners with 80-mesh screens[b]	Total PM	3	D	0.0072-0.0096 (0.016-0.021)	0.0084 (0.019)	10
Unloading fan	Total PM	2	B	0.093-0.23 (0.21-0.52)	0.16 (0.36)	11
No. 1 dryer and cleaner	Total PM	3	A	0.13-0.21 (0.29-0.45)	0.16 (0.35)	11
No. 2 dryer and cleaner	Total PM	3	A	0.044-0.064 (0.097-0.14)	0.056 (0.12)	11
Master trash fan	Total PM	3	A	0.10-0.12 (0.22-0.27)	0.11 (0.25)	11
First and second stage lint cleaners with screen cages	Total PM	3[c]	D	0.23-0.54 (0.51-1.2)	0.36 (0.80)	11
Mote system	Total PM	3	A	0.053-0.093 (0.12-0.21)	0.070 (0.15)	11
Battery condenser with screen cage	Total PM	3	D	0.044-0.14 (0.10-0.31)	0.098 (0.22)	11
Unloading fan	Total PM	3	A	0.083-0.15 (0.18-0.33)	0.11 (0.25)	11
No. 1 dryer and cleaner	Total PM	3	A	0.14-0.20 (0.30-0.44)	0.18 (0.39)	11
Second stage seed cotton cleaning	Total PM	3	A	0.017-0.021 (0.038-0.047)	0.020 (0.043)	11
No. 2 dryer and cleaner	Total PM	3	A	0.059-0.076 (0.13-0.17)	0.069 (0.15)	11
Master trash fan	Total PM	3	A	0.41-0.66 (0.89-1.4)	0.57 (1.3)	11
Gin stand feeder trash	Total PM	3	A	0.021-0.029 (0.046-0.063)	0.025 (0.055)	11

TABLE 4-1. (continued)

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
First and second stage lint cleaners with screen cages	Total PM	3[d]	D	0.49-0.91 (1.1-2.0)	0.70 (1.5)	11
Battery condenser with screen cage	Total PM	3	D	0.028-0.070 (0.062-0.15)	0.047 (0.10)	11
Unloading fan	Total PM	3	B	0.16-0.20 (0.35-0.43)	0.18 (0.40)	12
Nos. 1 and 2 dryers and gin stand trash	Total PM	3	B	0.14-0.17 (0.31-0.37)	0.16 (0.35)	12
Nos. 1 and 2 seed cotton cleaners	Total PM	4[e]	B	0.16-0.64 (0.35-1.4)	0.36 (0.79)	12
Mote system	Total PM	3	B	0.10-0.16 (0.22-0.36)	0.14 (0.30)	12
Mote cleaner	Total PM	3	D	0.066-0.094 (0.15-0.21)	0.075 (0.17)	12
First and second stage lint cleaners with screen cages	Total PM	3	C	0.54-1.0 (1.2-2.3)	0.73 (1.6)	12
Battery condenser with screen cages	Total PM	3	C	0.16-0.16 (0.35-0.36)	0.16 (0.36)	12
No. 1 dryer and cleaner	Total PM	3	A	0.12-0.15 (0.27-0.33)	0.14 (0.30)	13
No. 1 dryer and cleaner	PM-10	3	B	0.024-0.054 (0.054-0.12)	0.039 (0.088)	13
First and second stage lint cleaners	Total PM	3	A	0.16-0.21 (0.35-0.46)	0.18 (0.39)	13
First and second stage lint cleaners	PM-10	3	B	0.045-0.054 (0.097-0.12)	0.050 (0.011)	13
Lint cleaners	Total PM	3	A	0.029-0.22 (0.064-0.49)	0.14 (0.30)	14
Lint cleaners	PM-10	2	B	0.079-0.12 (0.17-0.26)	0.10 (0.22)	14
Unloading fan	Total PM	3	A	0.13-0.20 (0.29-0.45)	0.16 (0.34)	14
Unloading fan	PM-10	3	B	0.027-0.042 (0.060-0.093)	0.035 (0.078)	14
Master trash fan	Total PM	3	A	0.039-0.046 (0.087-0.10)	0.042 (0.092)	14
Master trash fan	PM-10	3	B	0.0039-0.018 (0.0086-0.040)	0.013 (0.029)	14
Mote trash fan	Total PM	2	B	0.024-0.026 (0.052-0.058)	0.025 (0.055)	14
Mote trash fan	PM-10	2	B	0.0080-0.0085 (0.018-0.019)	0.0083 (0.018)	14
Cyclone robber system	Total PM	3	A	0.072-0.092 (0.16-0.20)	0.083 (0.18)	14
Cyclone robber system	PM-10	3	B	0.015-0.037 (0.032-0.083)	0.024 (0.052)	14

TABLE 4-1. (continued)

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref. No.
Gin stand feeder trash	Total PM	3	A	0.017-0.019 (0.037-0.042)	0.018 (0.039)	14
Gin stand feeder trash	PM-10	3	B	0.0030-0.0047 (0.0065-0.010)	0.0041 (0.0089)	14
Mote system	Total PM	3	A	0.050-0.059 (0.11-0.13)	0.055 (0.12)	15
Mote system	PM-10	3	D	0.024-0.034 (0.053-0.074)	0.029 (0.064)	15
Battery condenser	Total PM	3	A	0.0055-0.0073 (0.012-0.016)	0.0059 (0.013)	15
Battery condenser	PM-10	3	B	0.0014-0.0055 (0.0030-0.012)	0.0036 (0.0079)	15
First and second stage lint cleaners	Total PM	3	A	0.016-0.068 (0.036-0.15)	0.041 (0.090)	15
First and second stage lint cleaners	PM-10	3	B	0.0068-0.030 (0.015-0.066)	0.020 (0.043)	15
Unloading fan	Total PM	3	A	0.11-0.16 (0.25-0.37)	0.15 (0.32)	16
Unloading fan	PM-10	3	B	0.038-0.064 (0.084-0.14)	0.052 (0.12)	16
Overflow fan	Total PM	3	A	0.045-0.082 (0.099-0.18)	0.059 (0.13)	16
Overflow fan	PM-10	3	B	0.016-0.019 (0.036-0.042)	0.017 (0.038)	16
Mote system	Total PM	3	A	0.031-0.059 (0.070-0.13)	0.045 (0.099)	16
Mote system	PM-10	3	B	0.011-0.052 (0.024-0.12)	0.027 (0.059)	16
No. 2 dryer and cleaner	Total PM	3	A	0.035-0.073 (0.076-0.16)	0.050 (0.11)	16
No. 2 dryer and cleaner	PM-10	3	B	0.010-0.030 (0.023-0.066)	0.018 (0.040)	16
Battery condenser	Total PM	3	A	0.0073-0.015 (0.016-0.034)	0.011 (0.024)	16
Battery condenser	PM-10	3	B	0.0019-0.0064 (0.0041-0.014)	0.0039 (0.0085)	16

[a] Sources controlled by high-efficiency 1D-3D or 2D-2D cyclones unless noted otherwise.

[b] Gin was processing first-harvest picker-harvested cotton.

[c] Three test runs conducted on each of four lint cages (two first stage and two second stage). Results are summed to determine a total emission factor for first and second stage lint cleaners.

[d] Three test runs conducted on one lint cleaner exhaust, and six test runs conducted on the other.

[e] Four test runs conducted at one exhaust and two valid test runs conducted at another exhaust point. Ninety-four percent of the emissions were measured at the site where four test runs were performed.

TABLE 4-2. EMISSION FACTOR DEVELOPMENT FOR COTTON GINNING

Source	Pollutant	No. of test runs	Data rating	Single test emission factors, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
Battery condenser	PM-10	3	B	0.0036 (0.0079)	0.0064 (0.014)	D	15
Battery condenser	PM-10	3	B	0.0039 (0.0085)			16
Battery condenser	PM-10	3	B	0.0058 (0.013)			6
Battery condenser	PM-10	3	B	0.0077 (0.017)			8
Battery condenser	PM-10	3	B	0.011 (0.025)			9
Battery condenser	Total PM	3	A	0.0059 (0.013)	0.018 (0.039)	D	15
Battery condenser	Total PM	3	A	0.011 (0.024)			16
Battery condenser	Total PM	3	A	0.016 (0.036)			9
Battery condenser	Total PM	3	A	0.019 (0.042)			8
Battery condenser	Total PM	3	A	0.037 (0.082)			6
Battery condenser with screen cages	Total PM	3	D	0.0059 (0.013)	0.078 (0.17)	E	10
Battery condenser with screen cages	Total PM	3	D	0.047 (0.10)			11
Battery condenser with screen cages	Total PM	3	D	0.098 (0.22)			11
Battery condenser with screen cages	Total PM	3	C	0.16 (0.36)			12
Cyclone robber system	PM-10	3	B	0.024 (0.052)	0.024 (0.052)	D	14
Cyclone robber system	Total PM	3	A	0.083 (0.18)	0.083 (0.18)	D	14
Gin stand feeder trash	PM-10	3	B	0.0041 (0.0089)	0.025 (0.055)	NR	14
Gin stand trash fan	PM-10	3	B	0.018 (0.040)			1
Gin stand trash fan	PM-10	2	B	0.036 (0.079)			4
Gin stand trash fan	PM-10	3	B	0.042 (0.093)			6
Gin stand feeder trash	Total PM	3	A	0.018 (0.039)	0.059 (0.13)	NR	14
Gin stand feeder trash	Total PM	3	A	0.025 (0.055)			11
Gin stand trash fan	Total PM	3	A	0.031 (0.068)			1
Gin stand trash fan	Total PM	3	A	0.11 (0.23)			6
Gin stand trash fan	Total PM	2	B	0.11 (0.24)			4
Lint cleaners	PM-10	3	B	0.020 (0.043)	0.11 (0.24)	D	15
Lint cleaners	PM-10	3	B	0.028 (0.062)			9
Lint cleaners	PM-10	3	B	0.050 (0.011)			13
Lint cleaners	PM-10	3	B	0.072 (0.16)			6
Lint cleaners	PM-10	2	B	0.10 (0.22)			14
Lint cleaners	PM-10	2	B	0.42 (0.93)			5
Lint cleaners	Total PM	3	A	0.041 (0.090)	0.26 (0.58)	D	15
Lint cleaners	Total PM	3	A	0.057 (0.13)			9
Lint cleaners	Total PM	3	A	0.13 (0.29)			6
Lint cleaners	Total PM	3	A	0.14 (0.30)			14
Lint cleaners	Total PM	3	A	0.18 (0.39)			13
Lint cleaners	Total PM	2	B	1.0 (2.3)			5

TABLE 4-2. (continued)

Source	Pollutant	No. of test runs	Data rating	Single test emission factors, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
Lint cleaners with screened drums	Total PM	3	D	0.14 (0.30)	0.49 (1.1)	E	10
Lint cleaners with screen cages	Total PM	3	D	0.36 (0.80)			11
Lint cleaners with screen cages	Total PM	3	D	0.70 (1.5)			11
Lint cleaners with screen cages	Total PM	3	C	0.75 (1.6)			12
Master trash fan (and gin stand feeder trash fan)	PM-10	3	B	0.017 (0.038)	0.034 (0.074)	D	14
Master trash fan	PM-10	3	B	0.051 (0.11)			7
~~Master trash fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.033 (0.073)~~			~~10~~
Master trash fan (and gin stand feeder trash fan)	Total PM	3	A	0.060 (0.13)	0.24 (0.54)	D	14
Master trash fan (and gin stand feeder trash fan)	Total PM	3	A	0.14 (0.31)			11
Master trash fan	Total PM	3	A	0.18 (0.40)			7
Master trash fan	Total PM	3	A	0.57 (1.3)			11
Mote fan	PM-10	2	B	0.023 (0.050)	0.060 (0.13)	D	4
Mote fan	PM-10	3	B	0.027 (0.059)			16
~~Mote fan~~	~~PM-10~~	~~3~~	~~D~~	~~0.029 (0.064)~~			~~15~~
Mote fan	PM-10	2	B	0.040 (0.089)			3
Mote fan	PM-10	3	B	0.048 (0.11)			9
Mote fan	PM-10	3	B	0.079 (0.17)			6
Mote fan	PM-10	2	B	0.14 (0.30)			5
~~Mote fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.032 (0.070)~~			~~10~~
Mote fan	Total PM	3	A	0.045 (0.099)	0.13 (0.28)	D	16
Mote fan	Total PM	2	B	0.049 (0.11)			4
Mote fan	Total PM	3	A	0.055 (0.12)			15
Mote fan	Total PM	3	A	0.070 (0.15)			11
Mote fan	Total PM	3	A	0.076 (0.17)			9
Mote fan	Total PM	2	B	0.095 (0.21)			3
Mote fan	Total PM	3	B	0.14 (0.30)			12
Mote fan	Total PM	3	A	0.15 (0.33)			6
Mote fan	Total PM	2	B	0.47 (1.0)			5
Mote trash fan	PM-10	2	B	0.0021 (0.0046)	0.0095 (0.021)	D	3
Mote trash fan	PM-10	2	B	0.0083 (0.018)			14
Mote trash fan	PM-10	3	B	0.018 (0.040)			2
~~Mote trash fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.020 (0.045)~~			~~10~~
Mote trash fan	Total PM	2	B	0.025 (0.055)	0.035 (0.077)	D	14
Mote trash fan	Total PM	3	A	0.031 (0.067)			2
Mote trash fan	Total PM	2	B	0.051 (0.11)			3

TABLE 4-2. (continued)

Source	Pollutant	No. of test runs	Data rating	Single test emission factors, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
~~Mote trash fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.075 (0.17)~~			~~12~~
No. 1 dryer and cleaner	PM-10	3	B	0.039 (0.088)	0.055 (0.12)	D	13
No. 1 dryer and cleaner	PM-10	3	B	0.040 (0.089)			9
No. 1 dryer and cleaner	PM-10	2	B	0.049 (0.11)			4
No. 1 dryer and cleaner	PM-10	3	B	0.050 (0.11)			6
No. 1 dryer and cleaner	PM-10	2	B	0.096 (0.21)			5

TABLE 4-2. (continued)

Source	Pollutant	No. of test runs	Data rating	Single test emission factors, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
~~No. 1 dryer and cleaner~~	~~Total PM~~	~~3~~	~~D~~	~~0.027 (0.059)~~			~~10~~
No. 1 dryer and cleaner	Total PM	3	A	0.11 (0.24)	0.17 (0.36)	D	6
No. 1 dryer and cleaner	Total PM	3	A	0.14 (0.30)			13
No. 1 dryer and cleaner	Total PM	2	B	0.14 (0.30)			4
No. 1 dryer and cleaner	Total PM	3	A	0.16 (0.35)			11
No. 1 dryer and cleaner	Total PM	3	A	0.18 (0.39)			9
No. 1 dryer and cleaner	Total PM	3	A	0.18 (0.39)			11
No. 1 dryer and cleaner	Total PM	2	B	0.25 (0.54)			5
No. 2 dryer and cleaner	PM-10	3	B	0.018 (0.040)	0.043 (0.093)	D	16
No. 2 dryer and cleaner	PM-10	3	B	0.022 (0.048)			9
No. 2 dryer and cleaner	PM-10	3	B	0.024 (0.053)			6
No. 2 dryer and cleaner	PM-10	3	B	0.042 (0.093)			1
No. 2 dryer and cleaner	PM-10	2	B	0.11 (0.23)			4
~~No. 2 dryer and cleaner~~	~~Total PM~~	~~3~~	~~D~~	~~0.017 (0.037)~~			~~10~~
No. 2 dryer and cleaner	Total PM	3	A	0.047 (0.10)	0.11 (0.24)	D	6
No. 2 dryer and cleaner	Total PM	3	A	0.050 (0.11)			16
No. 2 dryer and cleaner	Total PM	3	A	0.056 (0.12)			11
No. 2 dryer and cleaner	Total PM	3	A	0.069 (0.15)			11
No. 2 dryer and cleaner	Total PM	3	A	0.093 (0.21)			9
No. 2 dryer and cleaner	Total PM	3	A	0.10 (0.22)			1
No. 2 dryer and cleaner	Total PM	2	B	0.36 (0.79)			4
No. 3 dryer and cleaner	PM-10	3	B	0.014 (0.030)	0.015 (0.033)	D	2
No. 3 dryer and cleaner	PM-10	3	B	0.016 (0.035)			8
No. 3 dryer and cleaner	Total PM	3	A	0.041 (0.091)	0.043 (0.095)	D	2
No. 3 dryer and cleaner	Total PM	3	A	0.045 (0.099)			8
Nos. 1 and 2 dryers and gin stand trash	Total PM	3	B	0.16 (0.35)	0.16 (0.35)	NR	12
Nos. 1 and 2 seed cotton cleaners	Total PM	4	B	0.36 (0.79)	0.36 (0.79)	NR	12
Overflow fan	PM-10	3	B	0.0020 (0.0045)	0.012 (0.026)	D	9
Overflow fan	PM-10	3	B	0.012 (0.027)			6
Overflow fan	PM-10	3	B	0.016 (0.036)			2
Overflow fan	PM-10	3	B	0.017 (0.038)			16
Overflow fan	Total PM	3	A	0.0050 (0.011)			9
~~Overflow fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.013 (0.029)~~			~~10~~
Overflow fan	Total PM	3	A	0.020 (0.044)	0.033 (0.071)	D	6
Overflow fan	Total PM	3	A	0.046 (0.10)			2
Overflow fan	Total PM	3	A	0.059 (0.13)			16

TABLE 4-2. (continued)

Source	Pollutant	No. of test runs	Data rating	Single test emission factors, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
Overflow fan and master trash fan	PM-10	2	B	0.042 (0.092)	0.042 (0.092)	NR	3
Overflow fan and master trash fan	Total PM	2	B	0.45 (0.99)	0.45 (0.99)	NR	3
Second stage seed cotton cleaning	Total PM	3	A	0.020 (0.043)	0.020 (0.043)	NR	11
Third stage lint cleaners with 80-mesh screens	Total PM	3	D	0.0084 (0.019)	0.0084 (0.019)	NR	10
Unloading fan	PM-10	3	B	0.024 (0.053)	0.056 (0.12)	D	9
Unloading fan	PM-10	3	B	0.035 (0.078)			14
Unloading fan	PM-10	3	B	0.052 (0.12)			16
Unloading fan	PM-10	3	B	0.069 (0.15)			6
Unloading fan	PM-10	2	B	0.10 (0.22)			5
~~Unloading fan~~	~~Total PM~~	~~3~~	~~D~~	~~0.0078 (0.017)~~	0.13 (0.29)	D	~~10~~
Unloading fan	Total PM	3	A	0.041 (0.090)			9
Unloading fan	Total PM	2	B	0.10 (0.22)			5
Unloading fan	Total PM	3	A	0.11 (0.25)			11
Unloading fan	Total PM	3	A	0.14 (0.30)			6
Unloading fan	Total PM	3	A	0.15 (0.32)			16
Unloading fan	Total PM	3	A	0.16 (0.34)			14
Unloading fan	Total PM	2	B	0.16 (0.36)			11
Unloading fan	Total PM	3	B	0.18 (0.40)			12
Unloading fan and dryers and cleaners	PM-10	2	B	0.82 (1.8)	0.82 (1.8)	NR	3
Unloading fan and dryers and cleaners	Total PM	2	B	1.6 (3.6)	1.6 (3.6)	NR	3

[a] Emission factor units are kg (lb) of pollutant per bale of cotton processed. Sources controlled by high-efficiency 1D-3D or 2D-2D cyclones unless noted otherwise. NR = not rated. Crossed-out data are not included in the average emission factors shown.
[b] Emission factor not rated because emissions are accounted for in other emission factors.

TABLE 4-3. SUMMARY OF CANDIDATE EMISSION FACTORS FOR COTTON GINNING

Source	Pollutant	No. of tests	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Emission factor rating	Ref. No.
Battery condenser	PM-10	5	0.0036-0.011 (0.0079-0.025)	0.0064 (0.014)	D	6,8,9,15,16
Battery condenser	Total PM	5	0.0059-0.037 (0.013-0.082)	0.018 (0.039)	D	6,8,9,15,16
Battery condenser with screen cages	Total PM	4	0.0059-0.016 (0.013-0.36)	0.078 (0.17)	E	10-12
Cyclone robber system	PM-10	1	NA	0.024 (0.052)	D	14
Cyclone robber system	Total PM	1	NA	0.083 (0.18)	D	14
Lint cleaners	PM-10	6	0.020-0.42 (0.043-0.93)	0.11 (0.24)	D	5,6,9,13-15
Lint cleaners	Total PM	6	0.041-1.0 (0.090-2.3)	0.26 (0.58)	D	5,6,9,13-15
Lint cleaners with screened drums or cages	Total PM	4	0.14-0.75 (0.30-1.6)	0.49 (1.1)	E	10-12
Master trash fan	PM-10	2	0.017-0.051 (0.038-0.11)	0.034 (0.074)	D	7,14
Master trash fan	Total PM	4	0.060-0.57 (0.13-1.3)	0.24 (0.54)	D	7,11,14
Mote fan	PM-10	6	0.023-0.14 (0.050-0.30)	0.060 (0.13)	D	3-6,9,16
Mote fan	Total PM	9	0.045-0.47 (0.099-1.0)	0.13 (0.28)	D	3-6,9,11,12,16
Mote trash fan	PM-10	3	0.0021-0.018 (0.0046-0.040)	0.0095 (0.021)	D	2,3,14
Mote trash fan	Total PM	3	0.025-0.051 (0.055-0.11)	0.035 (0.077)	D	2,3,14
No. 1 dryer and cleaner	PM-10	5	0.039-0.096 (0.088-0.21)	0.055 (0.12)	D	4-6,9,13
No. 1 dryer and cleaner	Total PM	7	0.11-0.25 (0.24-0.54)	0.17 (0.36)	D	4-6,9,11,13
No. 2 dryer and cleaner	PM-10	5	0.018-0.11 (0.040-0.23)	0.043 (0.093)	D	1,4,6,9,16
No. 2 dryer and cleaner	Total PM	7	0.047-0.36 (0.10-0.79)	0.11 (0.24)	D	1,4,6,9,11,16
No. 3 dryer and cleaner	PM-10	2	0.014-0.016 (0.030-0.035)	0.015 (0.033)	D	2,8
No. 3 dryer and cleaner	Total PM	2	0.041-0.045 (0.091-0.099)	0.043 (0.095)	D	2,8
Overflow fan	PM-10	4	0.0020-0.017 (0.0045-0.038)	0.012 (0.026)	D	2,6,9,16
Overflow fan	Total PM	4	0.0050-0.059 (0.011-0.13)	0.033 (0.071)	D	2,6,9,16
Unloading fan	PM-10	5	0.024-0.10 (0.053-0.22)	0.056 (0.12)	D	5,6,9,14,16
Unloading fan	Total PM	8	0.041-0.18 (0.090-0.40)	0.13 (0.29)	D	5,6,9,11,12, 14,16
Total No. 1[b]	PM-10	NA	NA	0.37 (0.82)	D	1-9,13-16
Total No. 1[b]	Total PM	NA	NA	1.1 (2.4)	D	1-9,11-16
Total No. 2[c]	PM-10	NA	NA	0.54 (1.2)	E	1-9,13,14,16
Total No. 2[c]	Total PM	NA	NA	1.4 (3.1)	E	1-12,13,14,16

[a] Emission factor units are kg (lb) of pollutant per bale of cotton processed. Sources controlled by high-efficiency 1D-3D or 2D-2D cyclones unless noted otherwise. NA = not applicable.

[b] Total for gins with high-efficiency cyclones on all exhaust streams. Does not include emission factors for the No. 3 dryer and cleaner, cyclone robber system, mote trash fan, lint cleaners with screened drums or cages, and battery condenser with screened drums or cages.

[c] Total for gins with screened drums or cages on the lint cleaners and battery condenser and high-efficiency cyclones on all other exhaust streams. Does not include emission factors for the No. 3 dryer and cleaner, cyclone robber system, mote trash fan, lint cleaners with high-efficiency cyclones, and battery condenser with high-efficiency cyclones. PM-10 emissions from lint cleaners and battery condensers with screened drums or cages are estimated as 50 percent of the total PM emissions from these sources.

The emission factor ratings assigned to the factors for the revised AP-42 section are based on the guidelines presented in Section 3.3 of this report. All of the factors are assigned D or E ratings because the test data represent almost exclusively a single geographic region and may not be representative of facilities nationwide.

Candidate emission factors were developed for total PM and PM-10 emissions from the following sources: unloading fan, No. 1 dryer and cleaner, No. 2 dryer and cleaner, No. 3 dryer and cleaner, overflow fan, lint cleaners, cyclone robber system, mote fan, mote trash fan, battery condenser, master trash fan, and two total gin emission factors. Total No.1 represents total PM or PM-10 emissions from gins with all exhaust streams controlled by high-efficiency cyclones. Total No. 2 represents total PM or PM-10 emissions from gins with screened drums or cages controlling the lint cleaner and battery condenser exhausts and high-efficiency cyclones controlling all other exhaust streams. The No. 3 dryer and cleaner, cyclone robber system, and mote trash fan emission factors are not included in either total because these processes are not used at most cotton gins. However, these factors should be added into the total for a particular gin if these processes are used at that gin.

Data were also available for the gin stand trash fan, Nos. 1 and 2 dryers and gin stand trash fan, Nos. 1 and 2 seed cotton cleaners, overflow and master trash fan, second stage seed cotton cleaning, and unloading fan and dryers and cleaners. However, the emission factors developed with these data are not rated and are not included in the revised AP-42 section because the emissions from these sources are included in the other candidate emission factors. Use of these factors would result in double-counting of emissions from several sources.

4.4 SUMMARY OF CHANGES TO AP-42 SECTION

4.4.1 Section Narrative

The section narrative was reformatted and edited for technical accuracy, and revisions were made to reflect current industry practices. Review comments from industry were incorporated into the narrative.

4.4.2 Emission Factors

The emission factors presented in the previous version of AP-42 are not included in the revised AP-42 section for the reasons discussed in Section 4.2.18 of this report. The emission factors presented in Table 4-3 are presented in Table 9.7-1 in the draft AP-42 section. Due to revised guidelines for rating emission factors, the new emission factors are rated lower than the old factors. However, the new factors are based on more reliable and representative data than the old factors.

REFERENCES FOR SECTION 4

1. *Westfield Gin--PM10 & Total Particulate Testing--Main Trash Stock Piler Cyclone, #2 Incline Cyclone, Gin Feed Trash Cyclone*, BTC Environmental, Inc., Ventura, CA, November 14-15, 1991.

2. *Airways Gin--PM10 & Total Particulate Testing--Motes Trash Cyclone, #3 Incline Cyclone, Overflow Separator Cyclone*, BTC Environmental, Inc., Ventura, CA, November 21-22, 1991.

3. *Source Emission Testing--Mount Whitney Cotton Gin*, BTC Environmental, Inc., Ventura, CA, November 29-30, 1990.

4. *Source Emission Testing--Stratford Growers*, BTC Environmental, Inc., Ventura, CA, November 27-28, 1990.

5. *Source Emission Testing--County Line Gin*, BTC Environmental, Inc., Ventura, CA, December 3-4, 1990.

6. *County Line Gin--PM10 & Total Particulate Testing--Motes, Suction, Lint Cleaner, Overflow, #1 Drying, Gin Stand Trash, Battery Condenser, and #2 Drying Cyclones*, BTC Environmental, Inc., Ventura, CA, December 8-11, 1991.

7. *Westfield Gin--PM10 & Total Particulate Testing--Trash Cyclone*, BTC Environmental, Inc., Ventura, CA, November 12, 1992.

8. *West Valley Cotton Growers--PM10 & Total Particulate Testing--Battery Condenser and #3 Dryer/Cleaner Cyclones*, BTC Environmental, Inc., Ventura, CA, October 28, 1993.

9. *Dos Palos Cooperative--PM10 & Total Particulate Testing--Motes, Suction, Lint Cleaner, Overflow, #1 Drying, Battery Condenser, and #2 Drying Cyclones*, BTC Environmental, Inc., Ventura, CA, November 27-29, 1992.

10. *Halls Gin Company--Particulate Emissions from Cotton Gin Exhausts*, State of Tennessee Department of Health and Environment Division of Air Pollution Control, Nashville, TN, October 25-27, 1988.

11. *Cotton Gin Emission Tests, Marana Gin, Producers Cotton Oil Company, Marana, Arizona*, EPA-330/2-78-008, National Enforcement Investigations Center, Denver, CO, and EPA Region IX, San Francisco, CA, May 1978.

12. *Emission Test Report, Westside Farmers' Cooperative Gin #5, Tranquility, California*, Prepared for U.S. Environmental Protection Agency Division of Stationary Source Enforcement, Washington, D.C., PEDCo Environmental, Inc., Cincinnati, OH, February 1978.

13. *Elbow Enterprises--PM-10 and Total Particulate Testing, Lint Cleaner and Dryer #1 Cyclones*, AIRx Testing, Ventura, CA, November 7-8, 1994.

14. *Stratford Growers, Inc.--PM-10 and Total Particulate Testing, Unloading, Hull Trash, Feeder Trash, Lint Cleaner, Cyclone Robber System, & Motes Trash Cyclones*, AIRx Testing, Ventura, CA, October 26-28, 1994.

15. *Alta Vista Gin--PM-10 and Total Particulate Testing, Battery Condenser, Lint Cleaner, & Motes Trash Cyclones*, AIRx Testing, Ventura, CA, November 3-4, 1994.

16. *Dos Palos Coop Gin--PM-10 and Total Particulate Testing, Unloading, Dryer #2, Overflow, Battery Condenser, & Motes Cyclones*, AIRx Testing, Ventura, CA, October 31 through November 2, 1994.

17. Written communication from Fred Johnson and Phillip J. Wakelyn, National Cotton Council of America, Memphis, TN, to Dallas Safriet, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 31, 1995.

18. Written communication from Roger A. Isom, California Cotton Ginners Association, Fresno, CA, to Dallas Safriet, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 2, 1995.

19. Written communication from Thomas E. Goff, San Joaquin Valley Unified Air Pollution Control District, Bakersfield, CA, to Dallas Safriet, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 26, 1995.

5. PROPOSED AP-42 SECTION 9.7

The proposed AP-42 Section 9.7, Cotton Ginning, is presented on the following pages as it would appear in the document.

[Not presented here. See instead final AP-42 Section 9.7]