

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at [www.epa.gov/ttn/chief/ap42/](http://www.epa.gov/ttn/chief/ap42/)

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02\_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.



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AP-42 Section 9.7  
Reference 7  
Report Sect. 2  
Reference 9

PRODUCERS • GINNERS • WAREHOUSEMEN • MERCHANTS • CRUSHERS • COOPERATIVES • MANUFACTURERS

October 31, 1995

Mr. Dallas Safriet  
Environmental Engineer  
Emission Factor and Inventory Group  
U.S. Environmental Protection Agency  
Research Triangle Park, North Carolina 27711

Dear Mr. Safriet:

The National Cotton Council (NCC) and National Cotton Ginnings Association (NCGA) appreciates the opportunity to submit comments to the proposed revisions for Section 9.7: Cotton Ginning, AP-42, Compilation of Air Pollutant Emission Factors. NCC is the central organization of the cotton industry, representing producers, ginnings, warehouses, crushers, merchants, textile mills, and cooperatives. NCGA is the umbrella organization for eight state and regional ginner organizations, representing all ginnings in 17 states.

The attached comments were developed by industry's technical advisors after a thorough review of the draft proposed revisions:

Pages 2-1 through 2-3, and 2-5 through 2-11 (**William Mayfield**, Program Leader, Cotton Ginning and Mechanization, USDA Extension Service, Memphis, Tennessee)

Figures 2-1 and 9.7-2 (**Roy Baker**, Research Leader, USDA-ARS Cropping Systems Research Laboratory, Lubbock, Texas)

Section 9.7 (**Ed Hughs**, Research Leader, USDA-ARS Southwest Cotton Ginning Laboratory, Mesilla Park, New Mexico)

Other Comments on the Proposed Draft

Proposed changes made by Mayfield on the industry's description should be incorporated into the narrative in 9.7-1 through 9.7.6. Likewise, Baker's corrections to the flow diagrams should be included in Figures 9.7-1 and 9.7-2.

In Section 3, General Data Review and Analysis Procedures, we would point out that in the screening process, earlier emission tests were omitted from the current draft without proper justification. We feel that the data collected in 1977-78 from California and

Mr. Safriet  
October 31, 1995  
Page 2

Arizona is still applicable to current cotton gin emission factors. (Attached photographs are being submitted for your information.) Therefore, those data along with earlier data from the Parnell and Baker study, as well as data from four additional California gins, are included as references in Hughs' proposed emission factor tables. The additional emission data was included with the combined stripper and picker harvesting data in establishing average emission factors for all cotton regardless of harvesting method.

In Section 4, Review of Specific Data Sets, references 1 through 9 erroneously state that those facilities process stripper-harvested cotton. Therefore, Tables 4-1 and 4-3, Summary of Data for Ginning of Stripper Harvested Cotton, are misapplied. Reference 10 (Halls Gin, Halls, TN) of that section should note that these tests were conducted on early season, clean cotton and cannot be a representative average for a whole season's emissions. It should also be noted that data for the Halls Gin were not collected using Method 5 sampling.

Test data as discussed by Hughs support the following conclusions:

1. There is no reason to distinguish between emissions from ginning stripper-harvested and spindle picked cotton if the gin has high efficiency cyclones. The only emission data from stripper-harvested cotton is in Parnell and Baker's study (Hughs' reference 14).
2. A distinction between 1D3D and 2D2D cyclones under normal operating conditions is not justified because there is such a small difference in the overall efficiencies.
3. A distinction is justified for emissions from gins with high efficiency cyclones but with different collection devices for lint cleaner exhausts (-- cyclones vs. screens or lint baskets -- see Tables 4-1, 4-2, 4-3, and 4-4). Separate emission factors should be established for gins employing lint cleaner screens or baskets and those using high efficiency cyclones for their lint cleaners.

Draft Tables 9.7-1, 9.7-2, and 9.7-3, correctly includes both PM and PM10, which is an important distinction in light of EPA's recent guidance (Oct. 16, 1995) to states determining that PM10 will be the regulated pollutant under Title V of the Clean Air Act Amendments.

#### Summary

In summary, there should not be distinctions made between stripper and picker harvested cotton or between 1D3D and 2D2D cyclones; emission data for gins processing all cotton, regardless of harvesting method and type of high efficiency cyclones employed,

Mr. Safriet  
Page 3  
October 30, 1995

should be combined in calculating average emission factors; and the only distinctions in AP-42 for gin emissions should be for lint cleaner controls (cyclones vs. screens or lint baskets) and for total particulate (TSP) vs. PM10. In addition, we urge that EPA include all of the emission data referenced in Hughs' comments. In our view, the emission factors offered by Hughs take into account all relevant data and establish conservative, credible default numbers for use by both the ginning industry and state regulatory agencies.

Thank you again for allowing us to comment on your process to establish AP-42 emission factors for cotton gins.

Sincerely,

*Phillip Wakelyn - 202 745-7305*  
Phillip J. Wakelyn, PhD  
Manager of Environmental Safety and Health  
National Cotton Council of America

*Fred Johnson*  
Fred Johnson  
Executive Vice President  
National Cotton Ginners Association

The following comments relate specifically to section 4 of the revised draft report Emission Factor Documentation for AP-42, Section 9.7, Cotton Ginning.

1. Data in references numbered 1 through 9 in section 4.2 are not from stripper-harvested cotton but are from machine-picked cotton just as is reference 10. Stripper cotton is confined to the states of Texas, Oklahoma and New Mexico. Every other cotton growing state harvests machine-picked cotton only (this includes California). This is a basic error that will change how the data is analyzed and the tables are constructed.

2. In section 4.2.12, page 4-8, the second sentence of the opening paragraph states, "Because new emission data (for cotton ginning operations with PM controls) were obtained and the cotton ginning process and emission controls have changed since the early 1970's, the data in the background file are no longer used for emission factor development." The fact is that the basic cotton ginning process has not changed since the early 1970's, nor have the basic emission controls. Gin plants on the average are processing more bales per hour now than then, but they have increased by making the equipment wider or adding additional gin stands, not by changing the process. Many of the gins running in the 1970's are still running today.

The PM controls in use when the data for the 1977 version of AP-42 were taken were high efficiency cyclones (2D2D) on the seed-cotton exhausts and screened cages or baskets on the lint exhausts. This is almost exactly the same controls as are used by the Halls Gin, Halls, TN. The only difference is that the lint exhausts the Halls Gin used fine mesh screen on the lint condenser drums, while the earlier gins exhausted into baskets or cages covered with fine (80 to 100) mesh screen. Very little difference in the end result.

Many (but not nearly all) gins now use the 1D3D cyclone instead of the 2D2D, but the difference in their performance is only a matter of a small degree. Research done by both state and Federal agencies has shown that the 1D3D is usually (not always) slightly better in controlling particulate emissions in the 0 to 20 micron range than is the 2D2D. However, the difference is only 5 percentage points or so at most. Hardly a complete change in PM emission controls.

I agree that the uncontrolled emission factors collected in 1960 and previously tabulated in AP-42 are without merit and should be ignored. This data had very little relevance in the 1970's.

3. Given the previous two observations, four references from the 1977 version of AP-42 should be included in this version. The attached reference list gives them as reference numbers 11 through 14. Both the tests at the Marana Gin (reference 11) and the Westside Farmers' Cooperative Gin (reference 12) were conducted using EPA Method 5. The only deviation from that was that the emissions from the lint exhausts were measured using a Radar Sampler similar to that used at the Halls Gin. The Marana and the Westside Farmers' tests are still the most complete and technically correct tests that have been done to date. References 1 through 10 of the revised draft

(which correspond to references 1 through 10 of the attached list) give data that were collected one cyclone at a time. If a cyclone being measured was one of a set of multiple cyclones, the individual result was merely multiplied by the total number in the set. This simplifies things but leaves the data open to unknown and unmeasured variability. However, at the Marana and the Westside Farmers Gins, all multiple cyclone sets were manifolded together and the total emissions were sampled (reference pictures are available of the actual test setups). In addition, all gin exhausts were sampled so that an estimate of the total gin emissions were made using complete data. The newer tests are only samples of some of the exhausts of several different gins. These gins vary in size, design and operational details so that, at best, they only give a piecemeal picture of overall gin particulate emissions.

References 13 and 14 should be included for many of the same arguments as for 11 and 12. Data for these two tests were not collected using Method 5 but were taken with a different replicated isokinetic method. Reference 14 is the only reference for processing cotton that has actually been stripper-harvested.

4. Attached References 15,16,17, and 18 are additional tests done in 1994 on California cotton gins processing picker-harvested cotton. They are still only piecemeal samples of some exhausts as are References 1 through 10.

5. The previous comments make it necessary to rework the existing Tables 4-1, 4-2, 4-3, and 4-4. The attached Table 4-1 Cont'd and Table 4-2, Summary of Emission Factors, take into account all data from attached References 1 through 18. The Table 4-1 cont'd should merely attach to the end of the existing Table 4-1. Table 4-2 summarizes all data without separation of cyclone type, and includes both Total PM and PM10 summaries for different general gin exhaust types. There should be no Tables 4-3 or 4-4.

6. Because of the preceding changes, Draft Table 9.7-1 should also be reworked (see attached). As indicated on the attached Table 9.7-1, and based on all the available data, cotton gins with cyclones on all exhausts would be assigned a total PM emission rate of 0.89 kg/bale (1.97 lb/bale) and a PM10 emission rate of 0.35 kg/bale (0.58 lb/bale). Likewise, a gin with screened drums or cages on all lint exhausts would be assigned a total PM rate of 1.14 kg/bale (2.52 lb/bale).

TABLE 4-1 cont'd

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	Total PM	3	C	0.0074-0.0082 (0.016-0.018)	0.0078 (0.017)	10
No. 1 dryer and cleaner	Total PM	3	C	0.022-0.033 (0.049-0.073)	0.027 (0.059)	10
No. 2 dryer and cleaner	Total PM	3	C	0.016-0.018 (0.035-0.039)	0.017 (0.037)	10
Master trash fan	Total PM	3	C	0.028-0.037 (0.062-0.082)	0.033 (0.073)	10
Overflow fan	Total PM	3	C	0.012-0.014 (0.027-0.031)	0.013 (0.029)	10
Lint cleaners with screened drums	Total PM	3	C	0.13-0.15 (0.28-0.34)	0.14 (0.30)	10
Third stage lint cleaners with screened drums	Total PM	3	C	0.0072-0.0096 (0.016-0.021)	0.0084 (0.019)	10
Mote system	Total PM	3	C	0.029-0.034 (0.063-0.075)	0.032 (0.070)	10
Battery condenser with screened drums	Total PM	3	C	0.0050-0.0074 (0.011-0.016)	0.0059 (0.013)	10
Unloading fan	Total PM	2	B	0.094-0.235 (0.21-0.52)	0.16 (0.36)	11
#1 dryer and cleaner	Total PM	3	A	0.12-0.19 (0.27-0.43)	0.15 (0.33)	11
#2 dryer and cleaner	Total PM	3	A	0.044-0.065 (0.097-0.143)	0.056 (0.123)	11
Master trash fan	Total PM	3	A	0.089-0.111 (0.197-0.244)	0.10 (0.22)	11
1st and 2nd stage lint cleaners with screen cages	Total PM	3	A	0.094-0.15 (0.21-0.33)	0.12 (0.26)	11
Mote system	Total PM	3	A	0.053-0.094 (0.12-0.21)	0.071 (0.16)	11
Battery condenser with screen cage	Total PM	3	A	0.042-0.13 (0.092-0.29)	0.092 (0.20)	11
Unloading fan	Total PM	3	A	0.091-0.154 (0.20-0.34)	0.12 (0.26)	11
#1 dryer and cleaner	Total PM	3	A	0.13-0.20 (0.29-0.44)	0.17 (0.38)	11
2nd stage seed cotton cleaning	Total PM	3	A	0.016-0.021 (0.035-0.046)	0.019 (0.042)	11
#2 dryer and cleaner	Total PM	3	A	0.059-0.76 (0.13-0.17)	0.068 (0.15)	11

Source	Pollutant	No. of test runs	Data Rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref.* No.
Master trash fan	Total PM	3	A	0.39-0.68 (0.86-1.40)	0.57 (1.26)	11
Gin stand feeder trash	Total PM	3	A	0.021-0.027 (0.046-0.060)	0.025 (0.054)	11
1st and 2nd stage lint cleaners with screen cages	Total PM	3	A	0.34-0.42 (0.75-0.93)	0.37 (0.82)	11
Battery condenser with screen cage	Total PM	3	A	0.028-0.070 (0.062-0.15)	0.047 (0.10)	11
Unloading fan	Total PM	3	A	0.16-0.20 (0.35-0.43)	0.18 (0.40)	12
#1 and #2 drying and gin stand trash	Total PM	3	A	0.14-0.17 (0.31-0.37)	0.16 (0.35)	12
#1 and #2 seed cotton cleaners	Total PM	4	A	0.14-0.57 (0.30-1.26)	0.34 (0.74)	12
Mote system (combined)	Total PM	3	A	0.12-0.19 (0.26-0.42)	0.16 (0.35)	12
Mote cleaner	Total PM	3	A	0.066-0.094 (0.15-0.21)	0.075 (0.17)	12
1st and 2nd stage lint cleaners with screen cages	Total PM	3	A	0.12-0.19 (0.26-0.42)	0.16 (0.35)	12
Battery condenser with screen cages	Total PM	3	A	0.16-0.16 (0.35-0.36)	0.16 (0.36)	12
Unloading fan	Total PM	3	C	-	0.019 (0.042)	13
No. 1 dryer and cleaner	Total PM	3	C	-	0.032 (0.070)	13
No. 2 dryer and cleaner	Total PM	3	C	-	0.023 (0.051)	13
1st and 2nd stage lint cleaners with screens	Total PM	3	C	-	0.16 (0.35)	13
Mote system	Total PM	3	C	-	0.014 (0.031)	13
Battery condenser with screens	Total PM	3	C	-	0.032 (0.070)	13
Unloading fan	Total PM	3	C	-	0.27 (0.59)	14
No.1 dryer and cleaner	Total PM	3	C	-	0.10 (0.22)	14
No. 2 dryer and cleaner	Total PM	3	C	-	0.036 (0.079)	14
Master trash fan	Total PM	3	C	-	0.15 (0.34)	14

Source	Pollutant	No. of test runs	Data Rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref.* No.
Overflow fan	Total PM	3	C	-	0.015 (0.032)	14
1st and 2nd stage lint cleaners with screens	Total PM	3	C	-	0.39 (0.86)	14
Battery condensers with screens	Total PM	3	C	-	0.035 (0.078)	14
1st and 2nd stage lint cleaners with cyclones	Total PM	3	A	0.014-0.064 (0.031-0.14)	0.039 (0.085)	15
1st and 2nd stage lint cleaners with cyclones	PM10	3	B	0.0064-0.028 (0.014-0.062)	0.019 (0.041)	15
Mote system	Total PM	3	A	0.045-0.059 (0.10-0.13)	0.050 (0.11)	15
Mote system	PM10	3	B	0.024-0.033 (0.052-0.072)	0.029 (0.063)	15
Battery condenser with cyclones	Total PM	3	A	0.0045-0.0068 (0.010-0.015)	0.0054 (0.012)	15
Battery condenser with cyclones	PM10	3	B	0.0012-0.0050 (0.0027-0.011)	0.0031 (0.0069)	15
Unloading cyclone	Total PM	3	A	0.11-0.16 (0.25-0.36)	0.15 (0.32)	16
Unloading cyclone	PM10	3	B	0.038-0.064 (0.084-0.14)	0.050 (0.11)	16
#2 dryer and cleaner	Total PM	3	A	0.034-0.068 (0.074-0.15)	0.045 (0.10)	16
#2 dryer and cleaner	PM10	3	B	0.010-0.029 (0.022-0.063)	0.017 (0.038)	16
Overflow fan	Total PM	3	A	0.045-0.082 (0.10-0.18)	0.059 (0.13)	16
Overflow fan	PM10	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 (0.069-0.13)	0.044 (0.097)	16
Mote system	PM10	3	B	0.011-0.050 (0.024-0.11)	0.025 (0.056)	16
Battery condenser with cyclones	Total PM	3	A	0.0054-0.014 (0.012-0.032)	0.0095 (0.021)	16
Battery condenser with cyclones	PM10	3	B	0.0016-0.0050 (0.0035-0.011)	0.0031 (0.0069)	16
Unloading fan	Total PM	3	A	0.10-0.21 (0.23-0.47)	0.15 (0.33)	17
Unloading fan	PM10	3	B	0.027-0.033 (0.059-0.073)	0.031 (0.068)	17

Source	Pollutant	No. of test runs	Data Rating	Emission factor range, kg/bale (lb/bale)	Average emission factor, kg/bale (lb/bale)	Ref.* No.
Master trash fan	Total PM	3	A	0.041-0.059 (0.090-0.13)	0.050 (0.11)	17
Master trash fan	PM10	3	B	0.0054-0.018 (0.012-0.040)	0.014 (0.030)	17
Gin stand feeder trash	Total PM	3	A	0.017-0.018 (0.037-0.040)	0.018 (0.040)	17
Gin stand feeder trash	PM10	3	B	0.0029-0.0045 (0.0063-0.010)	0.0040 (0.0088)	17
Cyclone robber system	Total PM	3	A	0.072-0.091 (0.16-0.20)	0.082 (0.18)	17
Cyclone robber system	PM10	3	B	0.015-0.036 (0.032-0.079)	0.023 (0.051)	17
1st and 2nd stage lint cleaners with cyclones	Total PM	3	A	0.028-0.15 (0.061-0.34)	0.095 (0.21)	17
1st and 2nd stage lint cleaners with cyclones	PM10	3	B	0.054-0.10 (0.12-0.22)	0.045 (0.10)	17
Mote system	Total PM	3	A	0.024-0.032 (0.052-0.070)	0.027 (0.060)	17
Mote system	PM10	3	B	0.0077-0.010 (0.017-0.023)	0.0091 (0.020)	17
#1 dryer and cleaner	Total PM	3	A	0.12-0.15 (0.27-0.33)	0.14 (0.30)	18
#1 dryer and cleaner	PM10	3	B	0.024-0.054 (0.053-0.12)	0.039 (0.087)	18
1st and 2nd stage lint cleaning with cyclones	Total PM	3	A	0.16-0.21 (0.35-0.46)	0.18 (0.39)	18
1st and 2nd stage lint cleaning with cyclones	PM10	3	B	0.045-0.054 (0.10-0.12)	0.050 (0.11)	18

\*Reference 11 has source test data from two separate gin plants.

**TABLE 4-2. SUMMARY OF EMISSION FACTORS**

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	Total PM	11	D	0.0078-0.27 (0.017-0.59)	0.12 (0.27)	5,6,9-14, 16,17
Unloading fan	PM10	5	E	0.024-0.069 (0.053-0.15)	0.055 (0.12)	5,6,9,16,17
#1 dryer and cleaner	Total PM	11	D	0.027-0.25 (0.059-0.54)	0.12 (0.27)	4-6,9-14, 18
#1 dryer and cleaner	PM10	5	E	0.039-0.096 (0.087-0.21)	0.055 (0.12)	4-6,9,18
# 2 dryer and cleaner	Total PM	12	D	0.017-0.36 (0.037-0.79)	0.085 (0.19)	1,3,4,6, 9-14,16
#2 dryer and cleaner	PM10	5	E	0.017-0.042 (0.038-0.093)	0.043 (0.095)	1,4,6,9, 16
# 3 dryer and cleaner	Total PM	2	D	0.041-0.045 (0.091-0.099)	0.043 (0.095)	2,8
#3 dryer and cleaner	PM10	2	E	0.014-0.016 (0.030-0.035)	0.015 (0.033)	2,8
Master trash fan	Total PM	11	D	0.031-0.57 (0.068-1.26)	0.19 (0.42)	1,3,4,6, 7,10-12, 14,17
Master trash fan	PM10	6	E	0.014-0.051 (0.030-0.11)	0.034 (0.075)	1,3,4,6, 7,17
Overflow fan	Total PM	6	D	0.0050-0.059 (0.011-0.13)	0.026 (0.058)	2,6,9,10, 14,16
Overflow fan	PM10	4	E	0.0020-0.017 (0.0045-0.038)	0.012 (0.026)	2,6,9,16
Lint cleaners with cyclones	Total PM	7	D	0.038-1.00 (0.085-2.30)	0.23 (0.50)	4-6,9, 15,17,18
Lint cleaners with cyclones	PM10	7	E	0.019-0.42 (0.041-0.93)	0.094 (0.21)	4-6,9, 15,17,18
Lint cleaners with screened drums or cages	Total PM	6	D	0.14-0.73 (0.30-1.61)	0.44 (0.96)	10-14
Lint cleaners with screened drums of cages	PM10	no data				
Cyclone robber system	Total PM	1	D	0.082 (0.18)	0.082 (0.18)	17
Cyclone robber system	PM10	1	E	0.023 (0.051)	0.023 (0.051)	17

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 system	Total PM	12	D	0.014-0.47 (0.031-1.00)	0.10 (0.22)	2,3,5,6,9-13,15-17
Mote system	PM10	7	E	0.0091-0.14 (0.020-0.30)	0.052 (0.11)	2,3,5,6,9,15,17
Battery condenser with cyclones	Total PM	5	D	0.0054-0.037 (0.012-0.082)	0.018 (0.039)	6,8,9,15,16
Battery condenser with cyclones	PM10	5	E	0.0031-0.011 (0.0069-0.025)	0.0062 (0.014)	6,8,9,15,16
Battery condensers with screened drums or cages	Total PM	6	E	0.0059-0.16 (0.013-0.36)	0.062 (0.14)	10-14
Battery condensers with screened drums or cages	PM10	no data				

\*Reference 11 has 2 entries for many of the source categories.

Draft Table 9.7-1 (Metric and English Units)  
**EMISSION FACTORS FOR COTTON GINS CONTROLLED  
 WITH HIGH EFFICIENCY CYCLONES<sup>a</sup>**

Source	Total PM					
	PM		EMISSION FACTOR RATING	PM10		EMISSION FACTOR RATING
	kg/bale	lb/bale		kg/bale	lb/bale	
Unloading fan <sup>b</sup>	0.12	0.27	D	0.055	0.12	E
No. 1 dryer and cleaner <sup>c</sup>	0.12	0.27	D	0.055	0.12	E
No. 2 dryer and cleaner <sup>d</sup>	0.085	0.19	D	0.043	0.095	E
No. 3 dryer and cleaner <sup>e</sup>	0.043*	0.095*	D	0.015*	0.033*	E
Master trash fan <sup>f</sup>	0.19	0.42	D	0.034	0.075	E
Overflow fan <sup>g</sup>	0.026	0.058	D	0.012	0.026	E
Lint cleaners <sup>h</sup>	0.23	0.50	D	0.094	0.021	E
Lint cleaners with screened drums or cages <sup>i</sup>	0.44	0.96	D	ND	ND	-
Cyclone robber system <sup>j</sup>	0.082*	0.18*	D	0.023*	0.051*	E
Mote system <sup>k</sup>	0.10	0.22	D	0.052	0.11	E
Battery condenser <sup>l</sup>	0.018	0.039	D	0.0062	0.014	E
Battery condenser with screened drums or cages <sup>m</sup>	0.062	0.14	D	ND	ND	-
<b>Total**</b>	<b>0.89</b>	<b>1.97</b>	<b>D</b>	<b>0.35</b>	<b>0.58</b>	<b>E</b>

*Should be 0.21, not 0.021*

*0.77, not 0.58*

<sup>a</sup>Emissions are controlled by high efficiency cyclones unless noted.  
<sup>b</sup>References 5,6,9-14,16,17.  
<sup>c</sup>References 4-6,9-14,18.  
<sup>d</sup>References 1,3,4,6,9-14,16.  
<sup>e</sup>References 2,8.  
<sup>f</sup>References 1,3,4,6,7,10-12,14,17.  
<sup>g</sup>References 2,6,9,10,14,16.  
<sup>h</sup>References 4-6,9,15,17,18.  
<sup>i</sup>References 10-14.  
<sup>j</sup>References 17.  
<sup>k</sup>References 2,3,5,6,9-13,15-17.  
<sup>l</sup>References 6,8,9,15,16.  
 \*Most ginning systems do not have this feature as part of their system.  
 \*\*Total does not include the No. 3 drying, or cyclone robber system, and only cyclones on the lint cleaners and battery condenser.

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## 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<sup>1-8 [1-9]</sup>

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, ~~south to Alabama~~ [North Carolina, South Carolina, Georgia, Alabama and Florida]
- Mid-South--~~Kentucky and Missouri~~, ~~south to~~ [Tennessee], Mississippi, [Arkansas], and Louisiana
- Southwest--Texas and Oklahoma
- West--New Mexico, Arizona, ~~Nevada~~, and California

The majority of the ginning facilities are located in ~~Arizona~~, [Texas, Mississippi,] Arkansas, California, ~~Mississippi, and Texas~~ [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 ~~1990/1991~~ [1993/1994] season, the number of cotton gins in the United States dropped to ~~1,533~~ [1,364], but about ~~15,038,000~~ [15,691,000] bales were produced. The average volume processed per gin in ~~1990/1991~~ [1993/1994] was ~~9,810~~ [11,504] 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 ~~shortly after the cotton harvest 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 60 to 70 percent of the total cotton harvested, while machine-stripped cotton normally accounts for 30 to 40 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 less **[more]** trash than "first pick." "Ground cotton" may also be ~~vacuumed~~ **[picked up]** from the ground after picking. It has a high ~~trash~~ **[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 ~~500~~ **[480]** lb bale of lint, compared to 150 lb of trash per ~~500~~ **[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 ~~long staple or short staple~~ **[upland or extra long staple]**. Both types may be grown in the same area. ~~A large facility~~ **[Some facilities]** may devote separate gins to each type.

**[The modular system of seedcotton storage and handling has been rapidly adopted. This system stores seedcotton in the field after harvesting until the gin is ready to process it. Modules can also be transported longer distances, allowing gins to increase their productivity. In 1993, 74 percent of the U.S. crop was handled in modules.]**

## 2.2 PROCESS DESCRIPTION

**[Typically,]** modern cotton gins produce ~~8 to 30-500~~ **[10 to 60 480]**-lb bales/hour and 1,000 to ~~50,000~~ **[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 spindle-harvest seed cotton or about 2,400 lb of stripper-harvested seed cotton produce a ~~500~~ [480]-lb bale of lint cotton. Cotton gins ~~are fully automated and~~ can remove 90 to 99 percent of the trash and [all 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 Fiber 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 ~~and pollution control~~ equipment. Moisture content of raw cotton can range as high as ~~12~~ [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 ~~cotton seed~~ [cottonseed], 34 percent cotton lint, 1.5 percent cotton notes, 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 ~~cotton seed~~ [cottonseed], 23 percent lint, and 36 percent trash (23.4 percent burs, 7.2 percent leaf and dirt, 5.4 percent sticks).

### 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]. ~~and~~ [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 in series (see Figure 2-1).

~~[Seedcotton] Cotton~~ dryers are designed to reduce ~~[lint]~~ cotton moisture content to ~~6-5~~ [5] to 8 percent to facilitate cleaning and fiber/seed separation. A ~~push-pull~~, high-pressure fan ~~system~~ conveys seed cotton through the ~~tower dryer~~ [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. 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 then returns this cotton back to the screw conveyor distributor, as required. The air from this system is routed through a cyclone and cleaned before being exhausted to the atmosphere.

### 2.2.4 [Ginning and] Lint Cotton 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. (~~Some~~ [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 ~~any~~ [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. ~~One half of all the U.S. gins operate at a rate of 8 bales per hour or less, and only about 8 percent are rated at 29 bales per hour or more. Cotton bales produced in most gins are not compact enough to meet shipping requirements; thus, they must be sent to a compress warehouse for further compressing.~~ Modern gins are presently equipped with higher-tonnage bale presses that produce the more compact "~~universal sized~~" [universal density] cotton bales and ~~are also equipped with cotton sampling instruments, therefore bypassing the compress warehouse route.~~ [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 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 particulate 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. The air from each step in the process goes through a control device before being vented to the atmosphere.

~~Cotton field may be treated with any of several agricultural chemicals, including fertilizers, pesticides, and harvesting aids (such as defoliant and desiccants). Little information is available on emissions of any residues of such chemicals during the ginning process.~~ The harvesting of cotton can also 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<sub>2</sub> and small amounts of combustion by-products (e.g., benzene), but the extent of drying required varies widely; average emissions are ~~unknown~~ [relatively insignificant].

#### 2.4 EMISSION CONTROL TECHNOLOGY<sup>1,7-14</sup>

Cyclones are the principle control for particulate emissions on high-pressure airstreams in cotton gins. Properly designed and operated 2D2D or 1D3D cyclones remove over 99 percent of particulate by weight, and nearly 100 percent of particulate greater than 25 microns (9 μm). Cyclones operated in series have also proven successful.

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 particulate by weight.

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

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.

Wet scrubbers have been used with little success as primary control. The efficiency of particulate removal is lower than cyclones and the scrubber creates a water and sludge disposal problem. However, wet scrubbers have been proven successful as a secondary control device with cyclones. Testing indicated a wet scrubber can remove 73.5 percent of the particulate exhausted by a cyclone, which captured an average of 90.8 percent of gin emissions. Particulate removal for the combined system averaged 97.6 percent.

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 ~~has been essentially stopped~~ [all waste incineration has been eliminated] by pollution control regulations. ~~A few gins had apparently installed the more efficient and more costly multiple chamber incinerators by 1978, but no information was found on their acceptability or emissions.~~ [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 ~~batt~~ [lint], typically weighing about 500 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 ~~segregated~~ [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 ~~long or short staple~~ [upland or extra long staple], depending on fiber length.

Cotton seed [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 fed directly to cattle].

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

Cylinder cleaner - A machine with rotating spiked drums that open the ~~bolls~~ [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  $\mu\text{m}$ ) 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.

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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 ~~more~~ [less] trash than "second pick" cotton, obtained later in the harvest season. "Ground cotton" is obtained by ~~vacuuming~~ [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 ~~material~~ [seedcotton] from conveying air.

Skimmer - A curved air pollution control device that can separate part of the ~~small trash~~ [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.

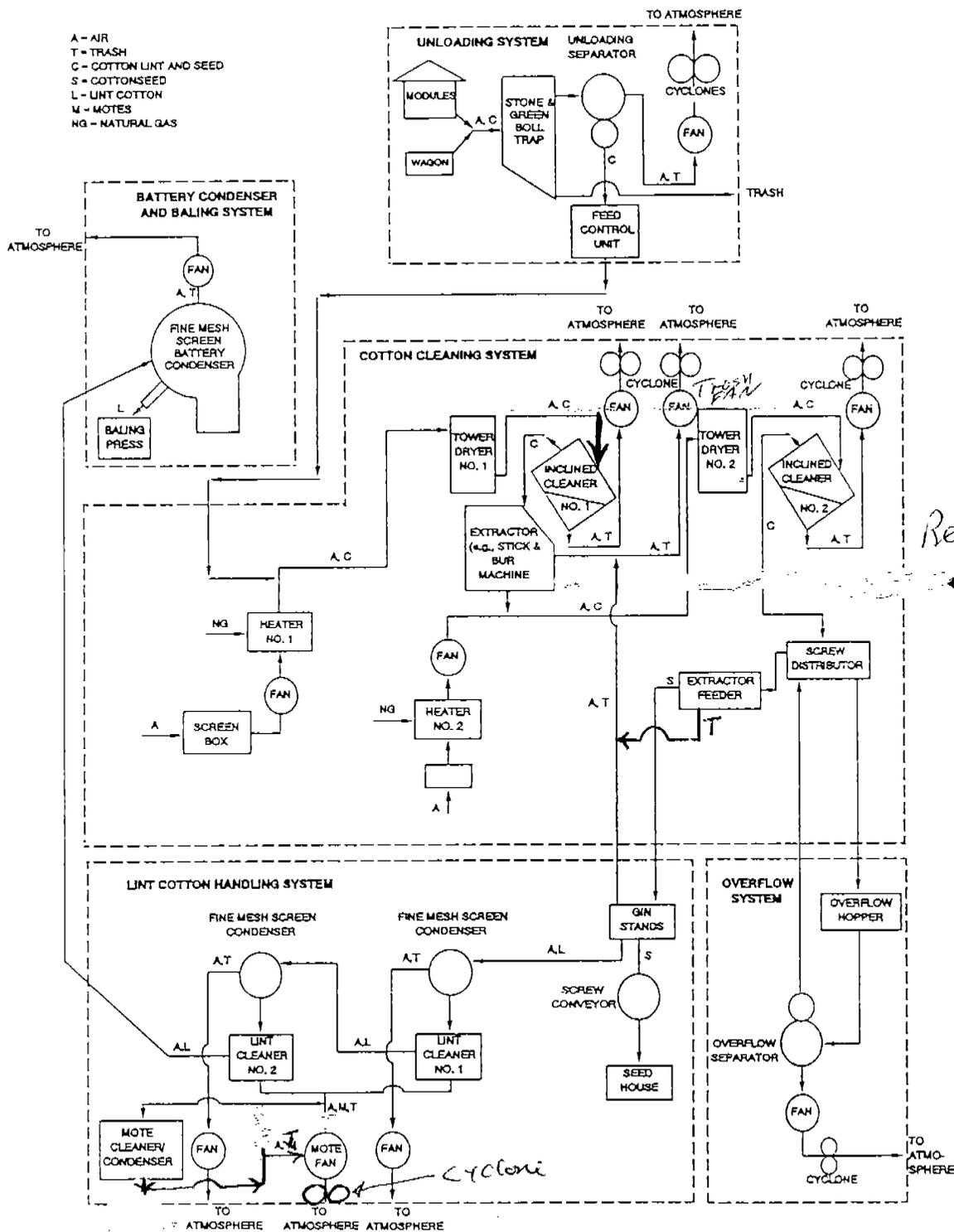
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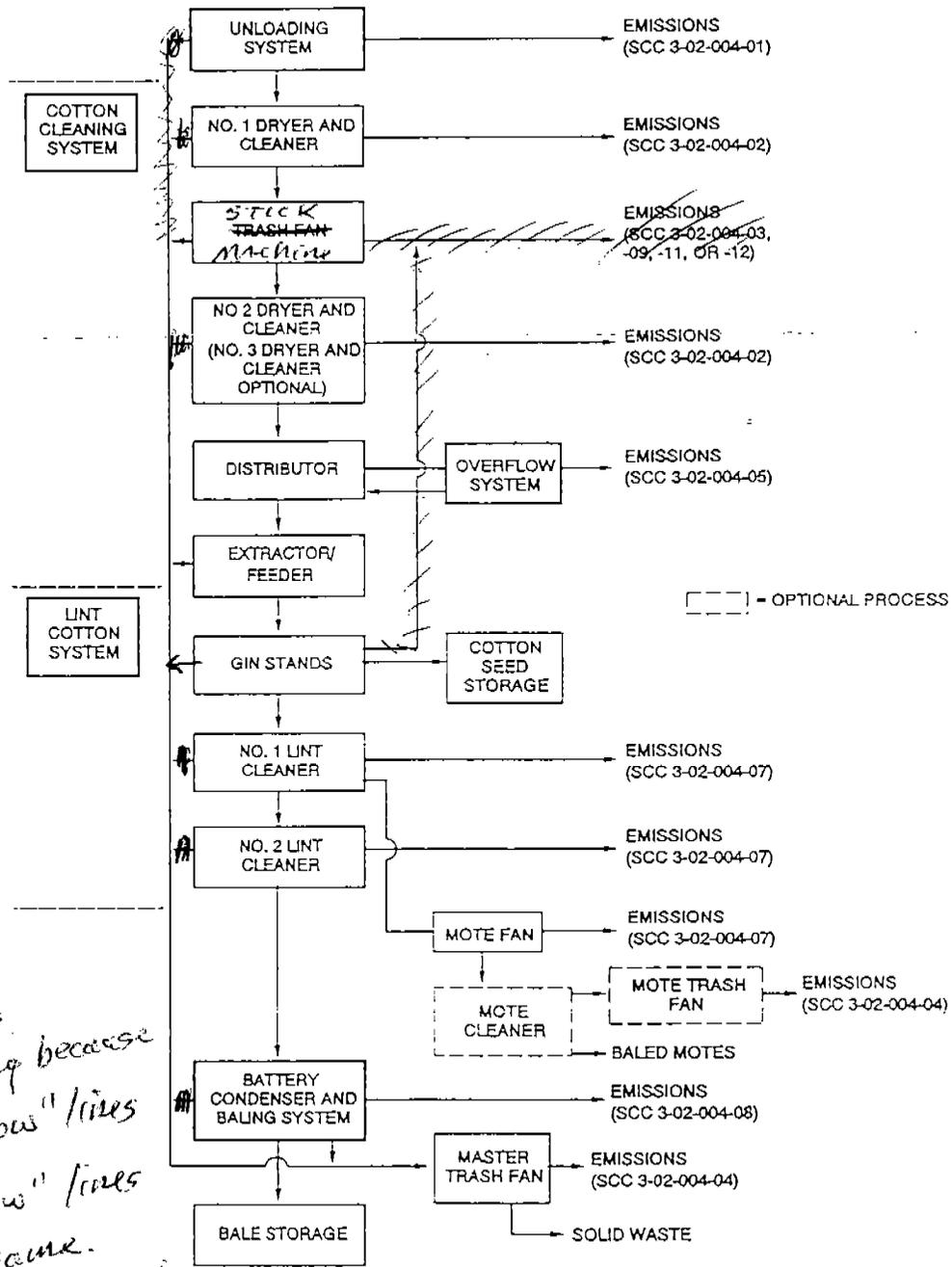
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Source: Adapted from AP-42 Section 6.3 (12/77).

Figure 2-1. Flow diagram of cotton ginning process.



*Chart is confusing because "Cotton Flow" lines and "Air Flow" lines look the same. Need to use different style of lines for Cotton, Air, etc.*

Figure 9.7-2. Emissions from a typical ginning operation. (Source Classification Codes in parentheses.)

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November 2, 1995

Mr. Dallas Safriet  
Environmental Engineer  
Emission Factor and Inventory Group  
U.S. Environmental Protection Agency  
Research Triangle Park, North Carolina 27711

Dear Dallas:

We ask that you replace Draft Table 9.7-1, sent in our earlier comments, with the one attached. This one reflects separate emission factors for gins with cyclones on condenser exhausts and those with screens or cages.

Thanks again for providing us the opportunity to comment.

Best regards.

Sincerely,

*Fred Johnson*  
Fred Johnson  
Ginner Representative

5 2.02

Draft Table 9.7-1 (Metric and English Units)  
**EMISSION FACTORS FOR COTTON GINS CONTROLLED  
 WITH HIGH EFFICIENCY CYCLONES<sup>a</sup>**

Source	Total PM					EMISSION FACTOR RATING
	PM		EMISSION FACTOR RATING	PM10		
	kg/bale	lb/bale		kg/bale	lb/bale	
Unloading fan <sup>b</sup>	0.12	0.27	D	0.055	0.12	E
No. 1 dryer and cleaner <sup>c</sup>	0.12	0.27	D	0.055	0.12	E
No. 2 dryer and cleaner <sup>d</sup>	0.085	0.19	D	0.043	0.095	E
No. 3 dryer and cleaner <sup>e</sup>	0.043*	0.095*	D	0.015*	0.033*	E
Master trash fan <sup>f</sup>	0.19	0.42	D	0.034	0.075	E
Overflow fan <sup>g</sup>	0.026	0.058	D	0.012	0.026	E
Lint cleaners <sup>h</sup>	0.23	0.50	D	0.094	0.021	E
Lint cleaners with screened drums or cages <sup>i</sup>	0.44	0.96	D	ND	ND	-
Cyclone robber system <sup>j</sup>	0.082*	0.18*	D	0.023*	0.051*	E
Note system <sup>k</sup>	0.10	0.22	D	0.052	0.11	E
Battery condenser <sup>l</sup>	0.018	0.039	D	0.0062	0.014	E
Battery condenser with screened drums or cages <sup>l</sup>	0.062	0.14	D	ND	ND	-
Total No. 1**	0.89	1.97	D	0.35	0.58	E
Total No. 2	1.15	2.52	D	0.50	1.10	E

<sup>a</sup> Emissions are controlled by high efficiency cyclones unless noted.

<sup>b</sup> References 5,6,9-14,16,17. <sup>c</sup> References 4-6,9-14,18.

<sup>d</sup> References 1,3,4,6,9-14,16. <sup>e</sup> References 2,8.

<sup>f</sup> References 1,3,4,6,7,10-12,14,17. <sup>g</sup> References 2,6,9,10,14,16.

<sup>h</sup> References 4-6,9,15,17,18. <sup>i</sup> References 10-14.

<sup>j</sup> References 17. <sup>k</sup> References 2,3,5,6,9-13,15-17.

<sup>l</sup> References 6,8,9,15,16.

\* Most ginning systems do not have this feature as part of their system and is not included in the totals. Would have to add this number to the total for those gins that have this feature.

\*\* Total 1 includes cyclones on all exhausts and Total 2 includes cyclones on all seed cotton exhausts and screened drums or cages on lint cleaners and battery condenser. PM10 figure for Total 2 includes an assumption that 50% of the PM weight is PM10 for the lint cleaner and battery condenser exhausts.