REGULATORY REVIEW OF OSHA'S COTTON DUST STANDARD [29 CFR 1910.1043]

Pursuant to Section 610 of the Regulatory Flexibility Act
and
Section 5 of Executive Order 12866

Prepared by
Office of Program Evaluation
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EXECUTIVE SUMMARY

The Occupational Safety and Health Administration's (OSHA's) regulation of cotton dust has been and continues to be a success. Since the standard was published in 1978, cotton textile workers' exposures to cotton dust have been greatly reduced and fewer workers have contracted byssinosis. Reductions in byssinosis rates have surpassed the reductions predicted at the time the standard was issued, and the rates have fallen from an average of approximately 12% to approaching or below 1%. Compliance with the standard, in many cases, occurred ahead of schedule, at lower than estimated costs, and with simultaneous increases in textile industry productivity and plant modernization. The standard has not had a significant impact on small business.

This regulatory review of the Cotton Dust Standard meets the requirements of both Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order (EO) 12866. Under Section 610, this review examines whether the standard should be continued without change, rescinded, or amended to minimize any significant impact on a substantial number of small entities considering the continued need for the rule, comments and complaints received, complexity of the rule, whether the rule is duplicative and changes since its issuance. Under Section 5 of EO 12866, this review examines whether the standard has become unjustified or unnecessary as a result of changed circumstances, and whether the standard is compatible with other regulations or is duplicative or inappropriately burdensome in the aggregate. This review also ensures that the regulation is consistent with the President's priorities and the principles set forth in EO 12866 within

applicable law, and examines whether the effectiveness of the standard can be improved. In order to assist OSHA in this review, OSHA requested public comments on these issues and held two public meetings.

The Section 610 review of the Cotton Dust Standard indicates the following:

- There is a continued need for the rule. Health studies continue to confirm that higher exposure than permitted by the rule or elimination of the medical surveillance, industrial hygiene and other provisions of the standard would increase workers' risk of developing byssinosis. The estimated prevalence of byssinosis cases has been reduced from approximately 50,000 in the early 1970s and 12,000 in the late 1970s to 700 since the mid 1980s, based on data from the U.S. Department of Labor and other data. OSHA inspections over the last twenty years have shown that violations of the cotton dust exposure limits and other requirements of the standard continue to occur, indicating that the standard would not be maintained voluntarily without an enforceable regulation.
- The rule is not unduly complex. OSHA public meetings in 1998 and comments to the Docket generated no complaints about the standard's complexity.
- The Cotton Dust Standard does not overlap with other regulations. In particular, the standard does not overlap with the Respiratory Protection Standard.
- Spurred by competition and the OSHA Cotton Dust Standard, there have been extensive technological improvements and increased productivity within the textile industry. Productivity, which had been growing at a rate of 2.5% per year in the 1972 to 1979 period before the standard, increased to a growth rate of 3.5% per year from 1979 to 1991 after the standard was issued.

- Small businesses in the cotton textiles industry are maintaining or increasing profitability and market share, despite a trend toward consolidation. The number of very small businesses is increasing. There is no evidence that small businesses are being placed at a competitive disadvantage as a result of the Cotton Dust Standard. Small businesses, as defined by the Small Business Administration (SBA), increased sales from about $34 billion to $36.5 billion from 1996 to 1998, and the smallest firms increased their sales from $6 billion to $10 billion in that period.
- Modernization of machinery and installation of effective air filtration systems reduced cotton dust in work environments. The cotton textile industry continues to be profitable and the value of shipments continues to rise. Sales of companies within the major cotton-using Standard Industrial Classification codes (SICs) increased from approximately $20 billion in 1982 to $27 billion in 1992, to $38 billion in 1996 and $40 billion in 1998.
- Comments on the rule received during this review are limited to details, such as requests from the National Institute for Occupational Safety and Health (NIOSH) and the National Cotton Council (NCC) to change the baseline for spirometry tests and to add additional acceptable methods for washing cotton.

Consequently, OSHA concludes that the Cotton Dust Standard should be continued without change (except for expanding the washed cotton exemption discussed below) and should not be rescinded because it is necessary to carry out statutory objectives to protect worker health and changes are not needed to minimize significant impact on a substantial number of small entities.

The Executive Order 12866 review of the standard indicates that:

- The Cotton Dust Standard remains both justified and necessary. Many comments support the continued need for the standard in its present format, and studies continue to indicate the need to protect the health of cotton textile workers.

- The Cotton Dust Standard is compatible with, not duplicative of, other OSHA standards, and is not inappropriately burdensome in the aggregate.
- The standard is compatible with the President's priorities and effective in achieving its mission.

Other observations:

- Technological improvements have lowered the cost and increased the effectiveness of cotton dust control. The cotton textile industry's economic competitiveness and productivity have improved since the standard was published.
- The 1998 textile industry is more modern and more productive than it was in 1978. No testimony in the 1998 comments or at the public meetings suggested negative economic impact, even for the smallest companies. During more than twenty years of cotton dust regulation, despite mergers and consolidation, the number of smallest establishments increased more than 40%.
- The cost of the Cotton Dust Standard was much lower than predicted at the time the rule was issued. OSHA estimated that the capital costs for the textile industry of the Cotton Dust Standard would be $550 million dollars in 1977, which was at the low-end of various estimates presented during the rulemaking. The actual capital cost was $243 million dollars in 1982 dollars, or $153 million in 1977 dollars.

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[29 CFR 1910.1043]

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REGULATORY REVIEW OF OSHA'S COTTON DUST STANDARD [29 CFR 1910.1043]

Pursuant to Section 610 of the Regulatory Flexibility Act
and
Section 5 of Executive Order 12866

September 2000

INTRODUCTION

INTRODUCTION AND NATURE OF THE REVIEW

In 1998, the Occupational Safety and Health Administration (OSHA) began a review of its Cotton Dust Standard under Section 610 of the Regulatory Flexibility Act[1] and Section 5 of Executive Order (EO) 12866 on Regulatory Planning and Review.[2]

The purpose of a review under Section 610 of the Regulatory Flexibility Act:

> "(S)hall be to determine whether such rule should be continued without change, or should be rescinded, or amended consistent with the stated objectives of applicable statutes to minimize any significant impact of the rules on a substantial number of small entities."
>
> "The Agency shall consider the following factors:
>
> (1) The continued need for the rule;
>
> (2) The nature of complaints or comments received concerning the rule from the public;
>
> (3) The complexity of the rule;

[1] 63 FR 34140 (June 23, 1998). For complete text of the Regulatory Flexibility Act, Section 610, 5 U.S.C. 601 *et seq.*, see Appendix I.

(4) The extent to which the rule overlaps, duplicates or conflicts with other Federal rules, and, to the extent feasible, with State and local governmental rules; and

(5) The length of time since the rule has been evaluated or the degree to which technology, economic conditions, or other factors have changed in the area affected by the rule."

The review requirements of Section 5 of EO 12866 require agencies:

> "To reduce the regulatory burden on the American people, their families, their communities, their State, local, and tribal governments, and their industries; to determine whether regulations promulgated by the [Agency] have become unjustified or unnecessary as a result of changed circumstances; to confirm that regulations are both compatible with each other and not duplicative or inappropriately burdensome in the aggregate; to ensure that all regulations are consistent with the President's priorities and the principles set forth in this Executive Order, within applicable law; and to otherwise improve the effectiveness of existing regulations."

To carry out these reviews, on June 23, 1998, OSHA asked the public for comments on all issues raised by these provisions (63 FR 34140). Specifically, OSHA requested comments on: the benefits and utility of the rule in its current form and, if amended, in its amended form; the continued need for the rule; the complexity of the rule; and whether, and to what extent, the rule overlaps, duplicates, or conflicts with other Federal, State, and local government rules. OSHA also asked for comments on new developments in technology, economic conditions, or other factors affecting the ability of covered firms to comply with the Cotton Dust Standard and on alternatives to the rule that would minimize significant impacts on small businesses while achieving the objectives of the Occupational Safety and

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[2] For the text of EO 12866, see Appendix II.

Health Act.

OSHA accepted written comments from June 23, 1998 through August 31, 1998.[3] OSHA also conducted two public meetings, on July 24 and July 30, 1998, in Atlanta, Georgia and Washington, DC, respectively.[4] OSHA hired Ruth Ruttenberg & Associates, Inc., in association with Dennison Associates, Inc., to help with the Section 610 and Executive Order 12866 review of the Cotton Dust Standard. All documents and comments received relevant to the review, transcripts of the oral hearings and documents discussed in this report are available at the OSHA Docket Office, Docket No. H-052F, Room N-3625, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, DC 20210, Telephone: (202) 693-2350.

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[3] Federal Register, Vol. 63, No. 120, Tuesday, June 23, 1998, pp. 34140-34141.

[4] Ibid.

CHAPTER I

NEED FOR A COTTON DUST STANDARD

Exposure to cotton dust causes an acute and chronic respiratory illness called byssinosis, also known as "brown lung disease." Byssinosis was identified as a respiratory disease afflicting workers exposed to cotton dust in England as early as the mid-nineteenth century and became a compensable occupational hazard there in 1941. However, many in the United States denied that byssinosis existed in American textile mills.[5] Through the 1960s and 1970s, substantial scientific information linked exposure to cotton dust with respiratory disease. Congressional concerns about the health effects of such occupational hazards as cotton dust partially motivated passage of the Occupational Safety and Health Act.

Typical symptoms of byssinosis include wheezing, chest tightness, and coughing. Lung function is reduced, an effect that can be measured by various pulmonary function tests, such as the Forced Expiratory Volume in one second (FEV_1) test. In the early reversible stages of the disease, symptoms occur on Monday mornings, i.e., the first day of the work week, but dissipate over the week, and reappear the following Monday. The disease is reversible only in the sense that after the earliest symptoms develop, complete removal from all future cotton dust exposure will prevent these symptoms from recurring. After continued exposure, the effects appear throughout the work week. These symptoms eventually lead to irreversible, disabling, and sometimes fatal loss of pulmonary function from chronic obstructive respiratory disease.

Workers who develop byssinosis often retire early because they are so short of breath they cannot work or carry out simple tasks. Beyond breathing difficulties, other symptoms of exposure to cotton dust are headache, nausea, gastrointestinal

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[5] J. K. Corn, "Byssinosis -- An Historical Perspective," American Journal of Industrial Medicine, 1981, Vol. 2, No. 4, pp. 331-352.

symptoms, and influenza-like symptoms.

Acute symptoms of byssinosis and changes in pulmonary function are more common in workers doing the dustiest jobs – those involving stripping, carding, and spinning – compared to those working in slashing and weaving operations.[6] Epidemiological studies confirm that the incidence of byssinosis is highest in the early production areas of yarn preparation like carding.[7] (See Appendix III for process-related cotton dust hazards in textile mills.)

The preamble to OSHA's 1978 Cotton Dust Standard[8] analyzed the available studies and concluded that there was a direct dose-response relationship between cotton dust exposure and byssinosis. The following studies were among those to which OSHA accorded considerable weight:

- Merchant's studies, OSHA concluded, were among the most thorough evaluations of byssinosis in the U.S. textile industry and demonstrated a strong linear association between prevalence rates of byssinosis and the concentration of cotton dust particles as properly defined.[9] For untreated cotton, the prevalence of byssinosis increased with increased concentrations of dust levels. The prevalence rates noted for byssinosis were: 7% in cotton

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[6] D. H. Wegman, C. Levenstein, and I. A. Greaves, "Byssinosis: A Role for Public Health In the Face of Scientific Uncertainty," American Journal of Public Health, February 1983, Vol. 73, No. 2, pp. 188-192.

[7] J. Merchant, J. C. Lumsden, and K. H. Kilburn, "Dose-Response Studies in Cotton Textile Workers," Journal of Occupational Medicine, 1973, Vol. 15, pp. 222-230 and M. B. K. Molyneux and G. Berry, "The Correlation of Cotton Dust Exposure with Prevalence of Respiratory Symptoms," Proceedings of International Conference on Respiratory Diseases in Textile Workers, 1968, Alicante, Spain, pp. 177-183.

[8] U.S. Department of Labor, "Occupational Exposure to Cotton Dust: Final Mandatory Occupational Safety and Health Standards," Federal Register, Vol. 43, No. 122, June 23, 1978, pp. 27350, 27352-27358.

[9] The technical term is "lint-free respirable cotton dust," i.e., particles of cotton dust of approximately 15 micrometers or less aerodynamic equivalent diameter. The concentration of dust particles was measured by using a "vertical elutriator," a dust sampler, which has a particle size cut-off at approximately 15 micrometers aerodynamic equivalent diameter when operated at the flow rate of 7.4+/-0.2 liters of air per minute.

preparation and yarn areas at 100 $\mu g/m^3$ (micrograms/cubic meter), 13% at 200 $\mu g/m^3$, and 26% at 500 $\mu g/m^3$. The prevalence of byssinosis was lower for blend mills and in weaving operations. Blend mills have lower cotton dust levels than equivalent areas of pure cotton mills, and weaving areas, unlike yarn preparation areas, had inert sizing included in the dust measured in weaving operations. Merchant found that prevalence rates in weaving were negligible at 200 $\mu g/m^3$, were 5% at 500 $\mu g/m^3$ and 15% at 1000 $\mu g/m^3$.[10]

- A 1973 study of chronic disease among textile workers in a South Carolina town found they suffered respiratory impairment at three times the rate of other blue-collar workers.[11]

- Data from detailed surveys at three large textile companies – Burlington Industries, Cone Mills, and West Point Pepperell -- were pooled by the American Textile Manufacturers Institute (ATMI),[12] for a study of nearly 500 workers. Data for all three mills indicated a significant relationship between exposure and prevalence of byssinosis with a substantial increase in risk associated with exposure[13] at or above

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[10] J. Merchant, J. C. Lumsden, and K. H. Kilburn, "Dose-Response Studies in Cotton Textile Workers," Journal of Occupational Medicine, 1973, Vol. 15, pp. 222-230.

[11] A. Bouhuys. C. A. Mitchell, R. S. Schilling, and E. Zuskin, "A Physiological Study of Byssinosis in Colonial America," Transactions of the New York Academy of Sciences, November 1973, Vol. 35, No. 7, pp. 537-546.

[12] ATMI is the national trade association for the domestic textile industry, which has member companies operating in more than 30 states and accounts for approximately 80% of all textile fibers consumed by mills in the United States. The study was by Dr. Hans Weill.

[13] While it was clear that cotton dust is associated with byssinosis, identifying the active agents causing the disease was more difficult. OSHA recognized cotton dust as a heterogeneous mixture containing active agents that were still unidentified. (See Appendix IV for recent studies identifying bacterial endotoxin as one of the active agents causing acute, and possibly chronic respiratory illness.)

500 μg/m³.[14] Researchers concluded that byssinosis prevalence is dependent upon the level of dust exposure, as well as the duration of exposure.

- Another industry-sponsored study, by Dr. Imbus of Burlington Industries, documented the relationship between dust exposure and byssinosis. It compared results from an initial medical survey of over 10,000 employees in 19 plants during 1970 to results collected in 1976 from more than 12,000 employees.[15] In the original screening, 460 (4%) of all exposed employees complained of subjective symptoms of grades ½ to 2 byssinosis[16] compared to 136 (1%) in 1976. The percentage of employees demonstrating a 10% or greater post-shift decrement in FEV_1[17] declined from 18% to 7%, between 1970 to 1976. Dr. Imbus credited significant reduction in dust levels, selective placement and transfer of employees, use of respirators by susceptible employees, counseling, and ongoing medical surveillance programs for the improvement.

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[14] U.S. Department of Labor, "Occupational Exposure to Cotton Dust: Final Mandatory Occupational Safety and Health Standards," Federal Register, Vol. 43, No. 122, June 23, 1978, pp. 27350, 27356.

[15] H. R. Imbus and M. W. Suh, "Byssinosis: A Study of 10,133 Textile Workers," Archives of Environmental Health, Vol. 26, No. 4, April 1973, pp. 183-191.

[16] The Schilling grading system for byssinosis reflects the differences in duration of the Monday morning symptoms:

Grade ½:	Occasional chest tightness or cough on the first day of the workweek.
Grade 1:	Chest tightness on every first day of the workweek.
Grade 2:	Chest tightness on the first and other days of the workweek.
Grade 3:	Grade 2 symptoms accompanied by evidence of permanent impairment from reduced ventilatory capacity.

(as presented in: Schilling et al., "A Report on a Congress on Byssinosis," Excerpta Medical International Congress Series 62, 1963, p. 138.)

[17] Pulmonary function can be evaluated through tests such as the forced expiratory volume in one second (FEV_1) or the forced vital capacity (FVC), which are frequently used to indicate reduction of normal respiratory function. Forced Expiratory Volume in one second is the amount of air one can forcefully exhale in the first second of the expiration. The normal range is 80% of the predicted value or greater. Predicted value is the amount of air that one should be able to forcefully exhale based on what other persons of the same height, sex, race, and age are able to do. Forced Vital Capacity is the amount of air one can forcefully exhale after maximum inspiration. The normal range is 80% of the predicted value or greater.

- The National Institute for Occupational Safety and Health (NIOSH), in reviewing work by the British Industrial Hygiene Society Committee on Hygiene Standards, estimated a prevalence of byssinosis ranging from 1.5 % for exposures less than 50 $\mu g/m^3$ to 55.0% for exposure levels of 400 to 500 $\mu g/m^3$.[18]

Based on these and other studies, OSHA concluded that cotton dust exposure caused high incidences of both acute and chronic byssinosis with a clear dose-response relationship, which varied by operation. OSHA also received extensive feasibility data. It set 8-hour time-weighted average exposure limits of 200 $\mu g/m^3$ (micrograms per cubic meter of air) of cotton dust for yarn preparation and spinning, 500 $\mu g/m^3$for waste houses, and 750 $\mu g/m^3$for slashing and weaving measured as the respirable fraction of airborne dust captured by the vertical elutriator. Based on predicted dose-response relationships, OSHA expected that there would be remaining significant incidence rates of byssinosis. However, OSHA felt it was not feasible to set lower levels.[19]

The Court of Appeals and the Supreme Court, as discussed below, upheld both the OSHA standard and analysis in these areas.[20] OSHA again confirmed these decisions and analysis when it further reviewed and amended the Cotton Dust Standard, after public notice and comment in the 1980s at 48 FR 26962 (June 10, 1982) and 50 FR 51120 (December 13, 1985).

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[18] National Institute for Occupational Safety and Health, "Criteria for a Recommended Standard: Occupational Exposure to Cotton Dust," 1974, Washington, DC, Government Printing Office, U.S. Department of Health Education and Welfare, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHEW Publication No. (NIOSH) 75-118, 1975.

[19] U.S. Department of Labor, "Occupational Exposure to Cotton Dust: Final Mandatory Occupational Safety and Health Standards," Federal Register, Vol. 43, No. 122, June 23, 1978, pp. 27350-27434.

[20] AFL-CIO v. Marshall, 617 F. 2d 636 (D.C. Cir. 1979); American Textile Mfgs. Inst. v. Donovan, 452 U.S. 490 (1981).

As discussed below, another Imbus study indicated that the Cotton Dust Standard was more successful than predicted in reducing acute byssinosis rates because of the beneficial effect of medical surveillance and worker transfer.[21] Two recent studies by Glindmeyer, et. al. indicate that the OSHA standard has been very effective in protecting workers from lung function declines in slashing and weaving.[22] However, as OSHA had originally predicted, lung function declines (not diagnosed byssinosis cases) are somewhat greater than normal for employees who smoke and who work in cotton spinning operations.

The data and evidence continue to confirm that the OSHA Cotton Dust Standard is necessary and has been effective in greatly reducing byssinosis in workers exposed to cotton dust. There is no evidence to indicate that the standard is unnecessary or is overly protective. The studies continue to indicate that the standard is necessary to protect worker health. No comments received by OSHA in the course of this regulatory review suggested that the exposure limits should be raised or that the standard should be eliminated.

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[21] H. R. Imbus, "Medical Surveillance Data in the Textile Industry," Ex. 175-60, Docket H-052C; 48 FR 26962, 26965 (June 10, 1983).

[22] H. W. Glindmeyer, J. J. Lefant, R. N. Jones, R. J. Rando, H. M. Abdel, and H. Weill, "Exposure-Related Declines in Lung Function of Cotton Textile Workers: Relationship to Current Workplace Standards," American Review of Respiratory Disease, 1991, Vol. 144, pp. 675-683, and H. W. Glindmeyer, J. J. Lefant, R. N. Jones, R. J. Rando, and H. Weill, "Cotton Dust and Across-Shift Change in FEV_1 as Predictors of Annual Change in FEV_1," American Journal of Respiratory and Critical Care Medicine, 1994, Vol. 149, pp. 584-590.

CHAPTER II

REGULATORY HISTORY AND REQUIREMENTS OF THE STANDARD

1. Regulatory History.

Cotton dust exposure in the United States was first regulated in 1968. Following extensive public hearings and numerous public comments, OSHA issued a new Cotton Dust Standard in 1978, and amended it in 1985. The important developments leading to the current Cotton Dust Standard are:

- In 1964, the American Conference of Governmental Industrial Hygienists (ACGIH) placed cotton dust on its tentative list of threshold limit values (TLVs), and in 1966 adopted a TLV of 1000 $\mu g/m^3$ of total cotton dust.

- In 1968, the Secretary of Labor, under the Walsh-Healey Act (41 U.S.C. 35 et seq.), adopted the 1968 ACGIH list of TLVs (which included for "cotton dust (raw)" the limit of 1000 $\mu g/m^3$) as Federal standards. OSHA adopted this Walsh-Healey limit in 1971 as an OSHA standard under Section 6(a) of the OSH Act.[23]

- In 1974, ACGIH adopted a TLV of 200 $\mu g/m^3$ for cotton dust. In September 1974, a NIOSH Criteria Document recommended a new standard of 200 $\mu g/m^3$ of lint-free cotton dust.

- On December 27, 1974, OSHA published in the Federal Register an Advance Notice of Proposed Rulemaking (ANPR)[24] for a new Cotton Dust Standard, requesting that interested persons submit their views on specific issues relating to cotton dust, particularly the NIOSH Criteria Document.

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[23] 36 FR 10466 (May 29, 1971).

[24] 39 FR 44679.

- In January 1975, the Textile Worker's Union of America filed a petition requesting that the Secretary propose a modified standard for occupational exposure to cotton dust, setting an exposure limit of 100 $\mu g/m^3$ meter. The North Carolina Public Interest Group joined this petition.

- In December 1976, OSHA published a proposed standard and notice of hearing in the Federal Register,[25] proposing a 200 $\mu g/m^3$ meter permissible exposure limit (PEL) for nearly all stages of cotton processing. The permissible exposure limit was to be achieved through engineering controls, supplemented by respirators if engineering controls were not feasible.

- On June 23, 1978, after receiving comments on its proposed standard, holding extensive public hearings, reviewing medical studies, and examining the costs of compliance for the cotton textile industry, OSHA issued a final Cotton Dust Standard.[26] That standard included a 200 $\mu g/m^3$ 8-hour time-weighted average PEL for opening and spinning, 750 $\mu g/m^3$ for slashing and weaving and a 500 $\mu g/m^3$ PEL for certain other processes. It included provisions on monitoring, medical surveillance, respirator use and other matters. A separate cotton ginning standard was also issued.[27] In September 1978, OSHA suspended application of the Cotton Dust Standard as it pertained to cotton waste processing industries (see Appendix V for an update on the cotton waste processing industries) and invited comments on a revised draft standard for that

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[25] 41 FR 54698.

[26] 43 FR 27350, 29 C.F.R. 1910.1043.

[27] 43 FR 27418.

industry.[28]

- Labor and industry immediately challenged the Cotton Dust Standard. (See Appendix VI for details of ensuing litigation after promulgation of the 1978 Cotton Dust Standard.) The U.S. Court of Appeals for the District of Columbia Circuit upheld the standard in almost all respects. (AFL-CIO v. Marshall, 617 F2d 636 (D.C. Cir. 1979.) It found ample scientific support for OSHA's conclusions that cotton dust caused byssinosis, and that it was technologically and economically feasible to reduce exposure.

- Separately, the U.S. Court of Appeals of the Fifth Circuit in Texas Independent Ginners Association v. Marshall, 63 F.2d 398 (1980) invalidated the regulation's application to cotton ginning, saying that OSHA had failed to show significant health risks for cotton gin workers. In response to the Court's decision, OSHA deleted the Cotton Ginning Standard from the Code of Federal Regulations (CFR).[29]

- In 1981, industry sought and received Supreme Court review of the appeals court decision upholding the Cotton Dust Standard. In American Textile Mfgs. Inst. v. Donovan, 452 U.S. 490 (1981), the Supreme Court upheld the standard in most respects, rejecting arguments that OSHA should have relied on cost-benefit analysis in setting the permissible exposure limits. The Supreme Court remanded to OSHA the standard's wage retention program for more detailed

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[28] The standard groups the non-agricultural cotton industry into two major categories: (1) textile industries, including yarn manufacturing and slashing and weaving, and (2) nontextile industries, including other sectors that use or handle cotton such as warehousing and compressing, waste houses, cottonseed milling, classifying and marketing, waste processing, and knitting operations. The industries covered by the 500 $\mu g/m^3$ PEL specified in the 1978 standard came to be called the "nontextile industries." This led to the rather confusing designation of the knitting industry as a nontextile industry, a nomenclature retained in OSHA documents.

[29] In October 1978, the DC Court of Appeals stayed enforcement of the Cotton Dust Standard in cottonseed oil mills, cotton waste operations, and cotton classing and warehousing. OSHA also stayed the standard in the knitting industry, which had not participated in the legal challenges, so that industry could submit, and OSHA could review new information on significant risk. (48 FR 5267, February 4, 1983)

explanation.[30]

- In 1983, OSHA issued a proposal to re-evaluate the 1978 Cotton Dust Standard.[31] OSHA proposed to retain the standard in major particulars in opening, spinning, waste processing, waste houses, slashing, and weaving operations. OSHA also proposed to substantially reduce regulation in knitting and the non-textile sectors of classing, warehousing and cottonseed processing (see Appendix V for an update on the cottonseed processing and waste processing industries) where evidence indicated there was much less risk. In addition, OSHA proposed various technical improvements and changes to clarify and improve the cost-effectiveness of the standard.[32] OSHA solicited public comments and held public hearings in September and October of 1983 in Washington, DC, Dallas, Texas, and Columbia, South Carolina.

- On December 13, 1985, at 50 FR 51120, OSHA revised the Cotton Dust Standards (29 CFR 1910.1043 and 1910.1000).[33] It retained the 200 $\mu g/m^3$ 8-hour Time-Weighted Average (TWA) exposure limit for spinning, 500 $\mu g/m^3$limit for waste houses, and 750 $\mu g/m^3$limit for slashing and weaving, and the major features of the standard for those sectors. OSHA applied the 1 mg/m^3 limit of 1910.1000 to waste processing and eliminated exposure limits for knitting and other non-textile segments because of lack of evidence of significant risk. OSHA retained medical surveillance for waste and cottonseed processing, but otherwise eliminated requirements for knitting and other non-

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[30] The wage retention provision of the standard assured that there would be no loss of earnings or employment rights to those employees that are transferred to low dust areas because of an inability to wear a respirator.

[31] 48 FR 26962, June 10, 1983.

[32] U.S. Department of Labor, "Preliminary Regulatory Impact and Regulatory Flexibility Analysis of the Proposed Cotton Dust Revision," Occupational Safety and Health Administration, June 1983.

[33] The revision provided that the waste-processing sector was covered by the 1000 $\mu g/m^3$ exposure limit in Table Z-1 of 1910.1000 and by the medical surveillance provisions of 1910.1043.

textile sectors. OSHA incorporated an action level, modified exposure monitoring requirements, extended compliance deadlines by two years for ring spinning of coarse count yarn with a high cotton content, added a protocol for determining equivalency to vertical elutriator testing, and excluded oil mist from the definition of cotton dust.

- The revised standard also incorporated a wage retention provision,[34] jointly recommended by the American Textile Manufacturers Institute (ATMI) and the Amalgamated Clothing and Textile Workers Union (ACTWU). It applies when an employee working in an area with cotton dust exposures above the PEL is unable to wear a respirator due to a medical condition. In that circumstance, the employee is to be transferred to an area with exposures below the PEL and is to suffer no loss of pay or benefits as a result of the transfer. The provision only comes into affect when a job is available or becomes available in an area with exposures below the PEL.

- OSHA substantially changed the washed cotton provisions. It partially exempted from the standard processing of washed cotton which met a revised and expanded definition. The revision provided complete exemption for "medical grade (USP) cotton, cotton that has been scoured, bleached and dyed, and mercerized yarn."

- These amendments became effective February 11, 1986. The unions and the textile industry did not challenge the amended standard. The standard was upheld against challenges by the cottonseed processing industry and from a respirator manufacturer.[35]

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[34] The Supreme Court initially invalidated a similar provision in the1978 standard because OSHA had not clearly explained a health-related need for the provision. Based on evidence indicating a health need for the provision and the recommendation of ATMI and ACTWU, OSHA incorporated a wage retention provision in the 1985 standard.

[35] National Cotton Seed Processing Association v. Brock, 825 F. 2d 482 (D.C. Cir, 1987).

- Occupational safety and health standards and enforcement are provided in 23 States and territories by States that operate their own OSHA-approved state plans covering private sector and State and local government employees, rather than Federal OSHA. Most of the cotton textile industry is located in States that operate such programs, e.g., North Carolina, South Carolina, California. All state plans adopted state standards equivalent to both the original 1978 Cotton Dust Standard and the 1985 revision. Although there were originally some differences, all state plan Cotton Dust Standards are now essentially identical to the Federal.

2. Requirements of the Cotton Dust Standard.

The Cotton Dust Standard prohibits employee exposure in the cotton textile industry to more than 200 $\mu g/m^3$ of lint-free cotton dust as an 8-hour TWA, measured by a vertical elutriator or an equivalent instrument, for opening and spinning. Higher exposure limits of 750 $\mu g/m^3$ meter apply for slashing and weaving operations and of 500 $\mu g/m^3$ meter in waste houses. The 1 mg/m^3 (1000 $\mu g/m^3$) limit of 1910.1000 applies to waste processing and no Permissible Exposure Limit (PEL) applies in cottonseed processing.[36, 37] Action levels of half the permissible exposure limit averaged over an eight-hour period apply to each operation covered by an exposure limit.[38] (See Appendix VII for the scope of application of the Cotton Dust Standard in different industry sectors.)

The Cotton Dust Standard requires that cotton dust exposure be reduced through primary reliance on engineering or work practice controls. If feasible engineering

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[36] Only paragraphs (h) Medical Surveillance, (k)(2) through (4) Recordkeeping – Medical Records, and Appendices B, C, and D of the standard apply in all workplaces where employees exposed to cotton dust engage in cottonseed processing and waste processing.

[37] The Cotton Dust Standard does not apply to the handling or processing of woven or knitted materials, to maritime operations covered by 29 CFR Parts 1915 and 1918, to harvesting or ginning of cotton, or to the construction industry. In addition, facilities that process washed cotton, as defined in 1910.1043 (n), may be exempt from all or part of the standard.

[38] 1910.1043 (c)(2).

and work practice controls are not sufficient to reduce employee exposure to or below the permissible exposure limit, the employer is required to institute controls to the lowest feasible level and then to supplement them with respirators.

The standard also requires implementation of:

1. Specified work practices. Each cotton textile employer must establish and implement a written work practices program to minimize cotton dust exposure. Work practices include floor sweeping with a vacuum or with methods designed to minimize dispersal of dust. In areas exceeding the PEL, cotton and cotton waste must be stacked, sorted, baled, dumped, removed, or otherwise handled by mechanical means except where the employer can show that it is infeasible to do so. Where infeasible, the method used for handling cotton and cotton waste must reduce exposure to the lowest level feasible.

   The cleaning of clothing or floors with compressed air is prohibited. Where compressed air is used for cleaning, the employees performing the "blow-down" or "blow-off" must wear suitable respirators.[39] Employees whose presence is not required for "blow-down" or "blow-off" must leave the affected area during this cleaning operation.

2. Medical surveillance program. Each employer covered by the standard must institute a medical surveillance program for all employees exposed to cotton dust. The surveillance should include pulmonary function measurement, including a determination of Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV_1), the FEV_1/FVC ratio, and the percentage that measured values of FEV_1 and FVC differ from predicted values, using the tables in Appendix C of the standard. Periodic examinations for all employees must include an update of the medical history, standardized

[39] "Blow-down" is the general cleaning of a room or a part of a room using compressed air . "Blow-off" is the use of compressed air for cleaning of short duration and usually for a specific machine.

questionnaire (App. B-III of the standard), Schilling byssinosis grade, and pulmonary function measurements.

3. Exposure monitoring. Each employer must conduct initial monitoring by obtaining measurements that are representative of the exposure of all employees to airborne concentrations of lint-free, respirable cotton dust over an eight-hour period. The employer is required to conduct periodic monitoring annually or every six-months depending on whether the levels are below, at, or above the specified PEL. Whenever there is a production, process, or control change that may change exposure levels, the employer must repeat the monitoring for affected employees.

4. Employee education and training programs. Along with providing a training program for all employees exposed to cotton, employers must assure that each employee is informed of both the acute and long-term health hazards associated with exposure to cotton dust; the names and descriptions of jobs and processes which could result in exposure to cotton dust at or above the PEL; the measures and work practices necessary to protect the employee from exposures in excess of the PEL; the purpose, proper use, and limitations of respirators required; the purpose for, and a description of, the medical surveillance program and other information which will help exposed employees understand the hazards of cotton dust exposure, and the contents of the Cotton Dust Standard and its appendices. The standard requires both initial and periodic training of employees.

5. Recordkeeping. The standard requires employers to establish and maintain an accurate record of all monitoring measurements and their details; the type of protective devices worn, if any, and length of time worn; and the names, social security numbers, job classifications, and exposure levels of employees whose exposure the measurement is intended to represent. The employer must maintain these records for at least 20 years.

6. Washed cotton. When raw cotton is washed in certain ways, it is biologically less reactive and creates a lesser or no risk of byssinosis, but may be more difficult to process. The standard provides for less or no regulation when processing washed cotton pursuant to various protocols. (See Appendix VIII for details of additional research on washed cotton.)

CHAPTER III

PROFILE OF THE COTTON TEXTILE INDUSTRY

The cotton textile industry modernized over the past twenty years, incorporating faster equipment, which yields a higher quality fabric and a less dusty work environment. To accommodate these changes, there has been significant integration both vertically (from early stages of cotton preparation through weaving or knitting) and horizontally (with more productive capacity for a single process), with many new market niches for small businesses. Sales and productivity are up, and the increased productivity has resulted in relatively better paid but fewer employees than 20 years ago. While there are fewer large companies, the number of very small companies has increased. The textile industry 20 years ago was protected by quotas and high tariffs. Various trade agreements are phasing out those quotas and tariffs.

The cotton textile industry engages in spinning cotton and cotton/synthetic blend fibers into yarns and threads, which are then converted into fabrics through weaving and knitting. The final stage consists of dyeing and finishing the fabrics. Cotton textiles are used principally in clothing, fabrics, toweling, linens, disposable diapers, tampons, medical uses, and miscellaneous uses such as erosion control.[40]

The cotton industry in the United States is divided into seven industrial divisions:[41] (1) ginning, to remove seeds, dirt, and other contaminants from the cotton, (2) warehousing and compressing cotton after ginning, (3) extracting cottonseed oil from the cottonseed separated during ginning, (4) classifying and marketing cotton, (5) manufacturing yarn, beginning with the opening of the cotton bales, (6) producing fabric by slashing and weaving, or knitting, and (7) processing cotton

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[40] U.S. Congress, Office of Technology Assessment, "The U.S. Textile and Apparel Industry: A Revolution in Progress -- Special Report," OTA-TET-332, Washington, DC, U.S. Government Printing Office, April 1987.

[41] U.S. Department of Labor, "Preliminary Regulatory Impact and Regulatory Flexibility Analysis of the Proposed Cotton Dust Revision."

waste including reclaiming cotton waste and producing cotton batting and felts. (See Appendix III for a flowchart of a typical textile manufacturing process.)

Weaving mills classified as broadwoven mills use the largest portion of textile yarn and they produce the raw textile material from which most textile products are made. Manufacturers of knit fabrics also use a sizable amount of textile yarn.[42] Within Textile Mill Products, Standard Industrial Classification (SIC) 22, there are nine three-digit codes and 22 four-digit codes. (See Table 1.) Some of the segments such as knitting and finishing are only slightly affected by the standard.

The cotton textile industry is geographically concentrated, with 95% of establishments in only four states – Alabama, Georgia, North Carolina, and South Carolina. Five of the ten largest textile companies in the U.S., in terms of 1995 sales volume, are located in North Carolina. (See Table 2.) Other states with textile mills include: Maine, Massachusetts, New York, New Jersey, Pennsylvania, Rhode Island, and Virginia. (For leading states by level of textile industry employment, see Table 3.) Many Finishing and Dyeing Operations (SIC 226) are in New Jersey. Most Narrow Fabrics and Manmade Fiber Mills (SIC 224) are in Rhode Island and Pennsylvania. Knitting Mills (SIC 225) and Miscellaneous Textile Mills (SIC 229) are scattered throughout many states.[43]

1. Textile Industry Sectors Covered by the Standard.

It is estimated that 466 of the 1601 establishments that manufactured yarn and wove fabrics in 1992 used cotton. (See Table 4.) Most textile establishments covered by the Cotton Dust Standard (approximately 82%) are in the Broadwoven Cotton Weaving (SIC 2211), Broadwoven Synthetic Weaving (SIC 2221), and Yarn Spinning (SIC 2281) sectors of the industry.

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[42] Environmental Protection Agency, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," Office of Compliance, Office of Enforcement and Compliance Assurance, EPA, EPA/310-R-97-009, September 1997, p. 19.

[43] Ibid., p. 8.

Other SIC industry sectors with significant cotton use are: Narrow Fabric Weaving (2241), Winding and Throwing (2282) and Thread Mills (2284).[44] The standard covers over 60% of the plants within Broadwoven Cotton Weaving (2211) and Thread Mills (2284). The standard covers less than 25% of plants in Broadwoven Synthetic Weaving (2221), Narrow Fabric Weaving (2241), Yarn Spinning (2281), and Winding and Throwing (2282). A few Knitting Mills (SIC 2250) manufacture cotton yarn and are, therefore, subject to the provisions of the standard.

2. Estimate of the Number of Establishments Covered by the Standard.

The number of establishments in "cotton-using 4 digit SICs" declined 5% from 1977 to 1992, and it is estimated that the number of establishments actually using cotton in 1992 declined a similar percentage with the result that about 466 textile establishments are currently covered by the Cotton Dust Standard.[45] Although the number of cotton textile establishments fell overall, the number of Broadwoven Weaving establishments has increased since the standard was published.

The growth in the number of establishments is mostly among small businesses, especially those with 1-19 employees. In Broadwoven Cotton Weaving, for example, according to SBA, the number of establishments with 1-19 employees nearly doubled, 1990 to 1996, from 149 to 291. (See Table 5.)

3. Increased Sales, Productivity and Wages.

Sales in the cotton textile industry have increased since the Cotton Dust Standard was issued. Value of shipments for major cotton-using 4 digit SICs in the textile

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[44] Centaur Associates, Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Part. I, Chapters 1-7, Report prepared for OSHA, January 1983, OSHA Docket H-052C, Exhibit 185.

[45] These data come from the U.S. Census of Manufacturers, 1977 and 1992. (See Table 5). Post-1992 data come from the Small Business Administration. (See Table 6.) These two data series report somewhat different numbers.

industry was approximately $20.1 billion in 1982 and $27.2 billion in 1992. Total sales for firms in these 4 digit SICs were $38.2 billion in 1996 and $39.8 billion in 1998. (See Tables 6 and 7.)[46]

Productivity in the textile industry has also increased substantially since the issuance of the Cotton Dust Standard. For example, productivity in the broadwoven fabrics industry increased from an annual rate of 2.5%, 1972-1979, to 3.5%, 1979-1991.[47]

The causes of this increased productivity were improved technology and a response to international competition.[48] As discussed below, the Cotton Dust Standard was a major impetus to the investment in new machinery.

Increased sales have come about at the same time that import quotas have been lifted or enlarged and import tariffs reduced. At the time the Cotton Dust Standard was issued, strict quotas protected the textile industry under the Multi-Fiber Agreement and textile imports had relatively high tariffs. During the late 1980s and 1990s the U.S. negotiated the Caribbean Basin Initiative, the North American Free Trade Agreement, and the World Trade Organization Agreement (Uruguay Round). These agreements have phased out quotas and reduced tariffs on textile imports.[49] The 1995 article in the Monthly Labor Review predicts that because of the high productivity and technological advancement of the textile industry, it will be in a good position to remain internationally competitive and maintain market share, nonetheless.

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[46] The 1982 and 1992 value of shipments data is from The U.S. Department of Commerce, "Census of Manufacturers," and 1996 and 1998 sales data from Dun and Bradstreet.

[47] M. Jablonski, "Multifactor Productivity Cotton and Synthetic Broadwoven Fabrics," Monthly Labor Review, July 1995, pp. 29-30.

[48] Ibid., p. 29.

[49] L. A. Murray, "Unraveling Employment Trends in Textiles and Apparel," Monthly Labor Review, August 1995, p. 62, 67-69.

During the 1990s, overall employment in the textile industry remained relatively stable, trending down somewhat. (See Table 8.) The reasons for the decline have not been attributed to the Cotton Dust Standard, but to increased productivity, industry consolidation, and to increased foreign competition.[50] Centaur estimated the number of cotton dust exposed workers as 104,800 in 1978. (See p.31 and Table 9 infra.) Since that time, increased use of cotton in textiles and increased volume of production would tend to increase the number of cotton dust exposed workers while increased productivity would tend to decrease it, those factors roughly balancing out.

Textile industry wages are increasing. Average hourly earnings in the textile industry climbed steadily over the past twenty years, with an increase of almost 140% from 1978 to 1998, from $4.11 in 1978 to $9.85 in 1998.[51] While actual pay is lower than the average for all manufacturing, the relative increase was higher. For all manufacturing (SICs 20-39), there was a 120% increase in average hourly earnings over the 20 years, from $5.91 in 1978 to $12.94 in 1998.[52]

4. Cotton Market Share is Now Increasing.

The use of cotton in U.S. textile production declined in the 1960s and 1970s, before publication of the Cotton Dust Standard. There is no evidence of a connection between this decline and the OSHA Cotton Dust Standard, which was finalized in 1978 after the period of decline. Cotton Incorporated, the trade association for the cotton industry, attributes the decline of cotton to the emergence of easy-care synthetic polyester textiles.[53] In 1960, cotton apparel and home fabrics accounted

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[50] Ibid., p. 69.

[51] Bureau of Labor Statistics, National Employment, Hours, and Earnings, Textile Mill Products, SIC 22, Average Hourly Earnings (excluding overtime), http://146.142.4.24/cgi-bin/dsrv, downloaded February 11, 1999.

[52] Ibid.

[53] Cotton Incorporated, "Cotton Incorporated: Company History," http://www.CottonInc.com/AboutCotton/homepage.cfm?PAGE=3&CFID=92356&CFTOKEN=51578804, downloaded August

for about 78% of all textile products sold at retail. By 1975 that share had been reduced to a low of 34%.

Other reasons given for the decline in the textile cotton share of the market were fashion changes and because the cotton industry did less promotion than the synthetic industry. The cotton industry, as a result of the decline in market share, increased promotion and product development.[54]

However, by 1983, cotton had registered significant market share gains. Cotton's share of the total textile market climbed five percentage points to 39%. By 1987 cotton had once again regained its position as the dominant fiber in the textile industry. Market share climbed to 49%.

Cotton is becoming a more important player in the market for non-wovens, a market that includes such major consumer product categories as disposable diapers, personal care products, and 100% cotton tampons. Cotton Incorporated predicts that by increasing production yields, reducing costs, improving fiber quality, creating new textile products, and implementing a successful marketing strategy, cotton will continue to be the dominant fiber in the world moving into the 21st century.[55]

5. The Future of the Textile Industry is Bright.

What is the prediction for the textile industry? The textile industry continues to grow and change. There was a temporary downturn in 1999 because of the general recession in Asia. But by investing in new technologies, merging to reduce costs, and developing new products and services, many textile companies have found new and stronger niches in international markets. Production is increasingly stable and companies are profitable. Small textile companies are increasing in number by

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5, 1999.

[54] Ibid.

[55] Ibid.

exploiting specialty markets. Textile companies remain an important provider of jobs, and many firms have adapted to technological and economic changes.[56] The changes now occurring in the technologies and economies within the industry are making it more nimble and competitive, better able to meet the demands of the consumer and, eventually, a stronger contributor to the U.S. economy.[57]

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[56] James C. Franklin, "Industry Output and Employment Projections to 2005," Monthly Labor Review, November 1995, pp. 45-59; and George T. Silvestri, "Occupational Employment to 2005," Monthly Labor Review, November 1995, pp. 60-84.

[57] Ibid.

CHAPTER IV

IMPACTS OF OSHA'S REGULATION OF COTTON DUST

The goal of the Cotton Dust Standard -- to reduce the risk of byssinosis -- has been achieved. The standard's emphasis has been on reducing exposures with engineering controls and using medical surveillance to monitor workers' health. To remain competitive and comply with the standard, the textile industry started a comprehensive modernization process, both of its equipment and operations. The technological upgrading and installation of new textile machinery, coupled with more efficient air filtration systems, reduced worker exposure to cotton dust. This modernization also led to significant increases in productivity.

The textile industry has successfully controlled cotton dust at most workplaces and reduced the risk of lung diseases for its workers. At the same time, pressure to comply with the Cotton Dust Standard encouraged creation of a clean, high-tech, and more productive textile industry -- one that is increasingly successful in meeting foreign competition. In addition, compliance has been achieved at a far lower cost than originally estimated.

1. Cotton Dust is Under Control in Most Textile Plants.

Textile industry executives have long believed that cotton dust is under control in most plants.[58] As early as 1991, an American Textile Manufacturers Institute (ATMI) spokesperson said that almost 100% of its members were in compliance with the standard.[59] Union and other industry spokespersons put the number closer to 80%, but also believed that the rest of the mills were not far behind.[60] Comments received in the cotton dust docket, and at public meetings held in 1998, specifically

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[58] J. Bone, "Textile Industry Weaves a Safer Future," Safety and Health, September 1991, pp. 48-53.

[59] Ibid.

[60] Ibid.

for this review of the Cotton Dust Standard, also indicate the cotton textile industry is largely in compliance with the standard.

Prior to the issuance of the standard in 1978, industry claimed that the Cotton Dust Standard was infeasible. Despite these claims, most cotton textile manufacturers met the PELs faster than OSHA's standard mandated.[61] According to a former official of both OSHA and ATMI,[62] "during the period 1973-1983, the textile industry improved the working environment for cotton dust and other hazards more than any other industry."[63] A 1983 Amalgamated Clothing and Textile Workers Union (ACTWU) study[64] showed cotton dust coming under control. This study, using industry data, concluded that 81% of workers were exposed to cotton dust levels at concentrations below the PEL. More than half of the reported dust levels were below the PEL in 11 of the 12 operations surveyed. The exception was opening operations, but they accounted for only 1.8% of covered workers.

A 1983 report[65] by Centaur Associates also indicated that dust concentrations were below the PELs specified for about 81% of the textile work force – 72% in yarn processing and 96% in weaving operations. Most of the workers in areas where exposures were over the PEL were wearing respirators. From the reports it is clear that at least the major companies began lowering exposures before the regulatory deadlines. Some companies began lowering exposure in the mid 1970s after OSHA

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[61] J. Pinkham, "Cotton Dust Standard Endures 10 Years," Occupational Health & Safety, May 1988, pp. 24-29.

[62] Ray Boylston was former OSHA director for North Carolina and former safety and health director of ATMI.

[63] Bone, 1991.

[64] E. Frumin, "The Economic Impact of the OSHA Cotton Dust Standard, Burlington Industries, Inc., Cannon Mills Co., Cone Mills Corp., Dan River Inc., Fieldcrest Mills Inc., J. P. Stevens & Co., Inc. and West Point-Pepperell, Inc." unpublished report, Amalgamated Clothing and Textile Workers Union (ACTWU), March 1983.

[65] Centaur Associates, Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Report prepared for OSHA, January 1983, OSHA Docket H-052C, Exhibit 185.

issued its original advance notice of proposed rulemaking. Consequently, by 1978, when OSHA issued the standard, byssinosis rates had already dropped from those in the early 1970s. Similarly, many mills came into compliance with the standard earlier than the standard's deadlines.

Developing and incorporating new control technologies into textile machinery and air filtration systems allowed for efficient dust control. According to the National Cotton Council (NCC),[66] "the newer filtration systems are computer controlled and can automatically make adjustments to maintain proper working conditions."[67] Currently, computer-integrated manufacturing uses machines that are easier to operate and more productive than their predecessors and optical scanning equipment is now being used to automatically check fabric for flaws.[68] Industry improvements in quality and production occurred with improvements in dust control. (See Appendix IX for a description of some of the new control technologies in textile machinery and air handling equipment.)

2. Fewer Cotton Textile Workers Suffer from Lung Disease Today Than in 1978.

It was estimated that 100,000 to 250,000 workers were exposed to cotton dust at levels, which could cause byssinosis in the mid to late 1970s. (See Table 9.) Approximately 35,000 active or retired workers had been disabled from cotton dust-related respiratory disease.[69]

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[66] The NCC is the central trade association of the American cotton industry representing producers, ginners, seed crushers, merchants, warehouses, cooperatives, and manufacturers in the 17 cotton producing states. NCC members include producers of over 75% of the U.S. cotton and cotton processing industries including non-textile and textile processing industries that are covered by the OSHA Cotton Dust Standard.

[67] Comments of Dr. Phillip Wakelyn, Senior Scientist, Environmental Health and Safety, National Cotton Council for America, submitted 1998 (OSHA Docket H-052F, Exhibit 3-5).

[68] M. Mittelhauser, "Employment Trends in Textiles and Apparel, 1973-2005," Monthly Labor Review, August 1997, pp. 25-35.

[69] A. Bouhuys et al., 1973.

Two reports, one by Centaur Associates[70] and another by the Department of Labor to the Congress,[71] estimated the number of workers exposed to cotton dust before issuance of the 1978 Cotton Dust Standard, the byssinosis rate, and the prevalence of byssinosis cases. Based on exposure reduction determined from the dose-response relationship only, these reports estimated reductions in the number of byssinosis cases and rates after the implementation of the Cotton Dust Standard. [72] (See Table 9.)

In 1983, Dr. Harold Imbus presented results from his review of medical surveillance data of 41,000 employees at seven textile companies.[73] The results of this study conducted in 1982, after the standard was mostly implemented, indicated a much greater reduction in the byssinosis prevalence rate and in the number of cases than was estimated by the Centaur Associates Report and the Report to Congress. Those reports estimated that an existing byssinosis rate of 7% to 26% in 1978 was expected to fall to 4% to 12% after implementation of the standard. The Imbus Report found that, by 1982, the byssinosis rate had fallen to less than 1%. (See

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[70] Centaur Associates Inc., January 1983, Supra Note 65.

[71] U.S. Department of Labor, "Cotton Dust: Review of Alternative Technical Standards and Control Technologies," Report to the Congress, 1979, OSHA Docket H-052B, Exhibit 169.

[72] The Centaur Report and the OSHA Report to Congress are lengthy reports with many methodological differences and varying strengths and weaknesses. The Centaur Report utilizes survey and site visit data to identify mills using cotton and the number of workers exposed to cotton dust. This will tend to underestimate workers exposed. The Report to Congress relies heavily on BLS statistics which do not identify mills. This will tend to overestimate the number of workers exposed. Both these reports use the same epidemiological studies to estimate dose response. Centaur combines the information into a single number, which is presented in Table 9. The Report to Congress presented rate estimates on a sector-by-sector basis. Table 9 combines those estimates. Both the Centaur and the Congress reports estimate the remaining number of cases after the standard fully took effect based on the dose-response curves. These curves only took exposures into account and not the further reductions in byssinosis resulting from medical surveillance, worker transfer, the action level and industrial hygiene requirements of the standard which have proved to lower byssinosis rates even further. (For example, cases of byssinosis might be reduced when workers identified as having stage 1 byssinosis are transferred to an area of the mill with low cotton dust exposure because they cannot wear a respirator.) Consequently, both reports substantially overestimate the number of remaining cases of byssinosis after the standard took effect.

[73] H. R. Imbus, "Medical Surveillance Data in the Textile Industry," OSHA Docket H-052C; Ex 175-60, 48 FR 26965, June 10, 1983 (Second report by Dr. Imbus referenced in this document).

Table 9 for a summary of these data and references.)

The Centaur Report estimated that there were 12,000 cases of byssinosis in 1978, and that after implementing the standard, the lower exposure limit would reduce the number of cases to 6,300. (All numbers given in this discussion are rounded to the nearest 100 cases.) However, the Imbus Report measured a much lower prevalence of byssinosis after the standard was implemented than Centaur had estimated. Therefore, using the Centaur Report estimate of workers exposed, and the Imbus Report byssinosis rate, the remaining cases of byssinosis after implementation of the standard is 700.

The number of byssinosis cases has dropped by 11,300, or 94%, since the promulgation of the OSHA standard, based on the Centaur Report estimate of workers exposed and the Imbus Report byssinosis rate. Note that these are prevalence numbers, the number of cases in the work force at any one time. The actual number of cases of byssinosis prevented would be much greater, because there is turnover in the workforce exposed to cotton dust. Workers with byssinosis, but no longer employed in a textile mill, are not counted in this analysis due to the lack of information about this population.

The Report to Congress estimated 51,300 cases of byssinosis because of a higher estimate of workers exposed, and it predicted the standard's lower exposure limits would reduce the number of cases by 25,200. If the Imbus Report measured prevalence rate is used, the number of cases would be reduced by 49,600 to 1,700 cases.

There are a number of factors explaining the range of estimates. Both the Centaur Report and Report to Congress used the Merchant studies[74] as the basis for estimating dose-response between cotton exposure levels and byssinosis rates. The dose–response curve varies by operation because cotton dust contains

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[74] J. Merchant et al., "Dose-Response Studies on Cotton Textile Workers," Journal of Occupational Medicine, 1973, Vol. 15, No. 3. Actually, there were 15 separate studies cited at 43 FR 27355 (June 23, 1978).

different percentages of constituent substances in each sector. For example, there is a higher byssinosis rate at a given cotton dust exposure level in spinning than in weaving.

The reports differed in the way they estimated the number of workers exposed to cotton dust. The Centaur Report relied heavily on survey data and site visits in 1982 as well as BLS data to estimate the 1978 number of mills using cotton, the proportion of workers exposed to cotton in the various mills, the types of operations, and the exposures. As a result, it is unlikely that it over-estimated the number of workers exposed, but it may have under-estimated the numbers because the survey may have missed some textile mills.

The Report to Congress used 1978 BLS data to estimate the number of mills and workers, and to adjust for those not exposed to cotton dust. This would not underestimate the number of exposed workers, but might tend to overestimate the numbers. The Department of Labor Report may more accurately reflect the higher number of byssinosis cases in the early to mid 1970s when there were more workers exposed at higher levels. The Advance Notice of Proposed Rulemaking (39 FR 44679, December 27, 1974) published by OSHA in 1974 and the Notice of Proposed Rulemaking published by OSHA in 1976 (41 FR 54698, December 28, 1976) did lead some mills to lower exposures prior to the issuance of the Federal standard. This additional reduction in byssinosis can be fairly attributed to OSHA actions.

The Merchant dose-response data by sector did not take into account the byssinosis lowering effects of the medical surveillance, action level, training, worker transfer, and work practice provisions of the standard. Workers in higher exposure areas who cannot wear respirators are to be transferred to lower exposure areas. Medical surveillance detects symptoms earlier and employers may transfer those workers to lower exposure areas. The action level concept encourages employers to reduce exposures below one-half the exposure limit by reducing regulation if they do so. Changes in work practices and training also

resulted in lower exposures.

The Imbus study was a review of 41,000 medical records of 7 companies after most of the standard had been implemented. The study concluded that the byssinosis ratio was 0.68%, and not the 2.5%–12.1% that would be predicted (depending on sector) based on the Merchant dose-response data alone. The Imbus Study has been subject to some criticism.[75] The author did not collect the primary data (that was done by the mills), and medical surveillance data did not have the uniformity in protocol that would have been desirable. Nonetheless, it is clear that the Cotton Dust Standard was more effective in reducing byssinosis rates than would be predicted from the dose-response rates alone.

The 11,300 estimate of byssinosis cases eliminated by the OSHA standard is definitely a low estimate. That estimate is based on the Centaur Report estimate of workers exposed, which probably missed some cotton dust exposed workers not picked up by the survey. The Report also gives no credit to the reductions in exposure and byssinosis cases caused by the announcement of the proposed OSHA standard in the mid 1970s. In addition, in all the data presented, the number of actual cases prevented is greater since the data are based on prevalence rates in the working population under study, and does not fully take into account the number of textile workers who developed byssinosis and subsequently left employment in the industry.

The Department of Labor's Report to Congress tends to reflect the higher exposures and greater number of workers exposed in the mid 1970s. Therefore, it includes some of the reductions in the byssinosis rates brought about by the advance notice of proposed rulemaking and the proposed OSHA standard, as well as the issuance of the final enforceable standard. It would also reflect the higher number of workers exposed in the mid 1970s when the industry had lower

[75] U.S. Congress, House Committee on Science and Technology, "A Review of the Scientific and Technological Issues in the Regulation of the Cotton Dust in Primary Cotton Textile Industry," U.S. GPO 1983, pp. 131-143.

productivity. Though it probably over-estimates the number of exposed workers and exposures in 1978, the estimate of 49,600 cases prevented using Imbus data is not an unrealistic estimate of the overall impact of the regulatory process and standard, especially considering the fact that it also does not include turnover rates in its estimates.

Other studies confirm the improved health of cotton textile workers. A study conducted by Merchant et al. in 1983 indicated that dust control, medical monitoring of workers, and work practice controls together appear to have accounted for a substantial reduction in the prevalence of byssinosis in many U.S. cotton textile mills.[76] In a 1985 study, Viscusi concluded that the standard had a substantial and beneficial effect on worker health and at a cost much lower than originally anticipated.[77]

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[76] J. A. Merchant, "Byssinosis: Progress in Prevention," American Journal of Public Health, 1983, Vol. 73, pp. 137-139.

[77] W. Kip Viscusi, "Cotton Dust Regulation: An OSHA Success Story?" Journal of Policy Analysis and Management, 1985, Vol. 4. No. 3, pp. 325-343. See also P. W. Kolp and W. K. Viscusi, "Uncertainty in Risk Analysis: A Retrospective Assessment of the OSHA Cotton Dust Standard," Advances in Applied Micro-Economics, 1986, Vol. 4, pp. 105-130.

3. Compliance Increased But Violations Persist.

In enforcing the standard over the past twenty years, OSHA compliance officers completed 245 inspections of cotton textile companies.[78] (See Table 10.) From these inspections, it is clear that industry made major production and equipment changes to significantly reduce worker risk. Still, there were 1,074 violations. (See Table 11.) Analysis of this compliance and enforcement history shows great improvements in overall compliance, but some gaps, especially in training, monitoring, and medical surveillance, still remain.

Type and Size of Companies Inspected. Most of OSHA's inspections were in larger facilities, and focused on two sub-industry sectors. Across all sizes of firms, the industrial categories (SICs) with the greatest number of inspections were yarn spinning mills (83 inspections), and broadwoven cotton mills (79 inspections), with a total of 69 inspections in SICs other than the major cotton-using sectors. (See Table 10.) The largest number of inspections was in firms with 100-500 employees, followed by inspections in the 20-99 and 501+ firm sizes. (See Table 11.)

Analysis of Violations. There were 67 violations for overexposure to cotton dust, or approximately 6% of the 1,074 violations. (See Tables 12 and 13.) Nearly three-quarters of these citations were in establishments with 500 or fewer employees; for the most part those would be small businesses, as categorized by the Small Business Administration (SBA).

Violations for overexposure were the third highest category of violations cited. Over 50% of the violations of the Cotton Dust Standard were in eight areas: training materials (94), periodic medical examinations (80), dust levels above the PEL (67), failure to implement engineering and work practice controls (63), initial monitoring (62), medical surveillance (62), work practices (59), and access to

[78] Data from OSHA's Integrated Management Information System (IMIS).

training materials (55). (See Table 14.) Fifty percent of the violations of the Cotton Dust Standard in the smallest cotton textile companies, those with 1 to 19 employees, were for medical surveillance (14), training program (13), initial monitoring (11), work practices (10), and access to training materials (9).

Most violations between 1980 and 1998, accounting for over two-thirds of the total violations, were in yarn spinning mills and broadwoven cotton mills. (See Table 13.) The smallest size employers, with 1-19 employees, were responsible for the least number of violations (though not the least per employee). Small businesses as a whole, generally as meeting the categories used by SBA, had the majority of violations. (See Table 15.) Firms with 100 to 500 employees received the most violations within SICs 2281, Yarn Spinning (216) and 2211, Broadwoven Fabrics (188). (See Table 15.) The 20-99 employee size companies within SICs 2281 and 2211 received the second largest number of violations. (See Table 15.)

4. The Textile Industry is Largely Modernized and More Productive

OSHA concluded that Cotton Dust Standard met the Agency's legal tests for technological and economic feasibility. The U.S. Court of Appeals for the District of Columbia and U.S. Supreme Court affirmed these Agency findings.[79] Since publication there has been further progress -- both technologically and economically. In its 1998 comments to OSHA, an American Textile Manufacturers Institute (ATMI) official said: "The textile workplace of today is clean and high-tech. The facilities have advanced ventilation systems and effective worker training and medical programs have been implemented."[80] An official from the National Cotton Council (NCC) reiterated ATMI's statement: "The industries that are

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[79] AFL-CIO v Marshall, 617 F. 2d 636 (D.C. Cir. 1979); American Textile Mfgs. Inst. v Donovan, 452 U.S. 490 (1981).

[80] Comments of Carlos Moore, Executive Vice President, American Textile Manufacturing Institute, submitted August 31, 1998 (OSHA Docket H-052F, Exhibit 3-1).

covered by the standard have effective ventilation systems and worker and medical programs have been implemented."[81]

There are several reasons for the high rate of compliance with the Cotton Dust Standard, and many are related to technological improvements. Money spent to improve textile industry productivity simultaneously solved dust problems, and vice versa. According to the medical director of Cone Mills in Greensboro, the textile industry gained in both financial as well as production areas by introducing new processes.[82] As far back as March 1984, an article reported that industry had spent $7.4 billion for new plant and equipment since publication of the standard. (See p.38 for a discussion of the cost of the OSHA standard.) Worker productivity nearly doubled from 1970 to 1983, and new machines produced cotton seven times faster than the old ones did.[83] Through most of the 1990s, the U.S. textile industry spent more than $2 billion a year on high-tech spinning machines, looms, and other equipment to improve its domestic and international competitiveness.[84] In 1997 alone, the U.S. textile industry spent over $2.8 billion to modernize its new plants and buy new equipment.[85] Modernization helped the industry to become more competitive and helped clear the work environment of dust.

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[81] Comments of Dr. Phillip Wakelyn, NCC, submitted 1998 (OSHA Docket H-052F, Exhibit 3-5).

[82] Bone, 1991, pp. 48-53.

[83] A. Field, "Textile Industry High Tech: Spurred by OSHA, It's Moving Fast," Dun's Business Month, March 1984, pp. 105-107.

[84] The American Textile Manufacturers Institute cited in J. S. McClenahen, "A Yarn That's No Tall Tale," Industry Week, July 1, 1996, Vol. 245, No. 13, pp. 59-61.

[85] Testimony of Carlos Moore, ATMI, before the Subcommittee on Telecommunications, Trade, and Consumer Protection, Committee on Commerce, U.S. House of Representatives, May 14, 1998, from Southern Textile News, May 25, 1998, Vol. 54, No. 21, p. 4.

Investment in new equipment made early compliance with OSHA's standard easier. A report for the Office of Technology Assessment[86] found that by 1983, the textile industry was already in substantial compliance with OSHA regulations for cotton dust. It also found that compliance was less expensive than OSHA or industry predicted because the new production processes were better at controlling dust, noise, temperature, and humidity. The report suggested that many textile mills might not have modernized as quickly and incorporated as much control technology without the impetus provided by the standard. Such modernization facilitated compliance and also increased productivity for cotton mills, resulting in lower capital expenditure for compliance than the industry or government had predicted. The report found that more redesigned equipment than add-ons was used by the industry than had been predicted before the standard was published.

Modern equipment has increased textile industry productivity. A 1982 study showed the value of firms within the textile industry increased simultaneously with cotton dust regulation.[87] It also showed firms with the highest percentage of cotton use experienced the largest productivity gains.

According to an Amalgamated Clothing and Textile Workers Union (ACTWU) study, the increased capital expenditures required to comply with the Cotton Dust Standard resulted in higher financial returns for affected companies and simultaneously protected the health of the workers.[88] After examining the economic performance of seven major companies with well-developed dust control programs,

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[86] Ruth Ruttenberg, "Compliance with the OSHA Cotton Dust Rule: The Role of Productivity Improving Technology," Final Report to the Office of Technology Assessment (OTA), U.S. Congress, March 1983, Contract No. 233-7050.0.

[87] T. Maloney and R. E. McCormick, "A Positive Theory of Environmental Quality Regulation," Journal of Law and Economics, April 1982, Vol. XXV, pp. 99-123. The study presents empirical evidence using financial market analysis of the OSHA Cotton Dust Standard and EPA's Clean Air Act of 1970 to demonstrate that environmental quality regulation may enhance producer wealth.

[88] E. Frumin, "The Economic Impact of the OSHA Cotton Dust Standard," unpublished report, Amalgamated Clothing and Textile Workers Union (ACTWU), March 1983.

ACTWU found that modernization also resulted in improvement in their international competitive positions. The union concluded that the Cotton Dust Standard's inducement toward investment in modern equipment enhanced the economic performance of these companies.

Additionally, The Economist reported positive economic effects of the standard:[89]

> "Tougher government regulations on workers' health have unexpectedly given the U.S. industry a leg up. Tighter dust control rules for cotton plants caused firms to throw out tons of old, inefficient machinery and to replace it with the latest available from the world's leading textile machinery firms in Switzerland and West Germany."

5. Compliance Costs Were Less Than Expected.

The various estimates of costs for the proposed Cotton Dust Standard substantially over-estimated compliance costs and did not estimate offsetting productivity benefits. Those estimates ranged from $543-$986 million in capital costs and $171-$279 million in annualized costs. OSHA's preferred estimate for the 1978 standard for the textile industry was $550 million of capital costs and $171 million in annualized costs in 1977 dollars.[90]

Industry challenged OSHA estimates, claiming compliance would cost more and imperil the industry. The DC Circuit and the Supreme Court rejected industry

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[89] The Economist, "Textiles Reel Off The Ropes," Business Brief, December 6, 1980, pp. 82-83.

[90] 43 FR 27350, 27380 (June 23, 1978). Research Triangle Institute (RTI), "Cotton Dust: Technological Feasibility Assessment and Final Inflationary Impact Statement," Part I, Report prepared for OSHA, 1976.

claims, finding substantial evidence to support OSHA estimates.[91] In fact, both industry and OSHA substantially over-estimated actual compliance costs.

In 1982 Centaur surveyed the actual costs to come into compliance for virtually every cotton textile mill in the country in 1982 dollars.[92] That study found that actual capital costs were $245 million and annualized costs were $83 million per year. Furthermore, these lower costs need to be counter-balanced by simultaneous productivity improvements.

There have been several studies discussing the over-estimation of costs for environmental and job protection regulations.[93,94] The over-estimates are not only by industry, but also by the regulating agency.

OSHA's contractor overestimated compliance costs at the time the standard was issued because it did not consider on-the-shelf equipment available from overseas manufacturers. Instead of estimating compliance costs using technologically improved engineering controls and more productive equipment, OSHA's contractor calculated economic feasibility using more expensive and less productive retrofit approaches. Industry's decisions post-publication to invest in modernization to reduce exposures resulted in much lower costs of compliance and increased productivity.

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[91] Supra Note 79.

[92] Centaur Associates 1983; 48 FR 26962, 26977 (June 10, 1983).

[93] E. Goodstein and H. Hodges, "Polluted Data: Overestimating Environmental Costs," The American Prospect, November - December 1997, pp. 64-69.

[94] W. Kip Viscusi, "Cotton Dust Regulation: An OSHA Success Story?" Journal of Policy Analysis and Management, 1985, p. 325.

CHAPTER V

IMPACT ON SMALL BUSINESSES

The main purpose of Section 610 of the Regulatory Flexibility Act (RFA) is "to minimize any significant economic impact of the rule on a substantial number of small entities in a manner consistent with the stated objectives of applicable statutes..." This chapter discusses the overall impact of the Cotton Dust Standard on small businesses. It demonstrates that small businesses have continued to prosper since the regulation was issued. Earlier chapters have shown that the industry has become more productive and that workers have become healthier – the latter being the goal of the applicable statute, the OSH Act. The following chapter discusses the more detailed requirements of Section 610 of the RFA.

Small businesses play a major role in the U.S. economy. They create two of every three new jobs, produce 39% of the Gross National Product, and are responsible for more than half the nation's technological innovation.[95] Small businesses have always been and continue to be an important part of cotton textile manufacturing.

The cotton textile industry, like many industrial sectors of the country, is a mix of large, middle-size, and small businesses. According to the Small Business Administration, companies employing 500 or fewer employees in broadwoven synthetic weaving (2221), narrow fabric weaving (2241), yarn spinning (2281), winding and throwing (2282), and thread mills (2284) are classified as small businesses. For broadwoven cotton weaving (SIC 2211), businesses with 1000 or fewer employees are considered small businesses. Based on these categories, the proportion of small business establishments in all these sectors is over 90%.

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[95] U.S. Small Business Administration, "Mission," http://www.sba.gov/intro.html, downloaded May 5, 1999.

Post-regulation, there has been a relative growth in small businesses in the cotton textile industry. In four of the six 4-digit textile SICs that dominate cotton textile manufacturing, the percentage of small establishments increased relative to the whole between 1977 and 1992.[96] (See Table 16.) In broadwoven cotton weaving, the proportion of small business rose from 91% to 96% of establishments. Small businesses in broadwoven synthetic weaving (manufacturing cotton/synthetic blends) rose from 77% to 88%. The yarn spinning proportion rose from 91% to 96%. The declines in percent of small businesses in the other two categories were less than one percent for each. In addition, when SBA data from 1990 to 1996 are examined, a similar trend of increase in the proportion of small-sized firms is evident for these major cotton-using textile SICs. (See Table 17.)

While most textile establishments are very small businesses, with fewer than 20 employees, the majority of textile production occurs in large companies.[97] As a result of mergers and consolidations in the textile industry, there was a 12% decline between 1977 and 1992 in the overall number of textile manufacturing establishments, though production was increasing. However, the number of establishments with fewer than 20 employees increased 21% -- from 530 in 1977 to 643 in 1992. (See Table 18.) The number of firms in the 1-19 employee class size also increased, by 55% between 1990 and 1996 -- from 503 in 1990 to 782 in 1996. (See Table 5.)[98] Consolidation continued to decrease the number of establishments in other size categories as production continued to increase. These data indicate that the smaller firms remained competitive.

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[96] 1992 is the last year for which the Census of Manufactures is available.

[97] Environmental Protection Agency, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," Table 3, p. 7, September 1997.

[98] These numbers come from different sources – one uses "firms" and the other "establishments" and thus they differ slightly.

One reason for the growth of smaller textile firms has been the creation of specialty niches, which emerged because large and middle-sized firms consolidated. Textile companies have integrated horizontally, i.e., they have merged similar production processes to obtain economies of scale to remain competitive. They have also integrated vertically, merging consecutive production processes like spinning and weaving. This resulted in some large mills employing anywhere from hundreds to thousands of workers. While integration brought some larger production facilities into the industry, it also created many specialty niches for smaller companies. These include production of specialty cotton blends as well as custom-ordered widths and finishes.

Other evidence that the Cotton Dust Standard has not hindered smaller firms comes from sales data. Those data indicate that recent sales of the smaller textile firms have increased more rapidly than the sales of larger firms. For example, Table 7 shows that between 1996 and 1998, sales of firms with 1-19 employees increased by approximately two-thirds and sales of firms from 20-99 employees increased by approximately 30%. Sales of firms with more than 500 employees decreased slightly in that period.

These data indicate that the existence of the Cotton Dust Standard has not caused smaller textile companies any significant negative economic impact generally or in relation to the larger textile companies. The number of smaller companies and the overall sales of smaller companies are increasing rapidly. Obviously, many factors are present in addition to the Cotton Dust Standard. But these numbers do not show significant negative impact, and comments by the public did not claim that the standard overall had a significant negative impact on small businesses.

Consequently, OSHA concludes that the Cotton Dust Standard should be continued without change (except for an expansion of the washed cotton

exemption discussed below) and should not be rescinded because it is necessary to carry out statutory objectives to protect worker health and changes are not needed to minimize significant impact on a substantial number of small entities.

CHAPTER VI

SECTION 610 REVIEW OF THE STANDARD

Section 610 of the Regulatory Flexibility Act directs agencies to review impacts of regulations on small businesses. Chapter V discussed the overall impact of the Cotton Dust Standard on small textile firms and found no negative impact.

Section 610 also provides that agencies should specifically consider five areas in reviewing the impact of a regulation on small businesses. This chapter covers the impact of the Cotton Dust Standard in those five areas, which are:

- The continued need for the Cotton Dust Standard.
- The concerns about the complexity of the rule.
- The extent to which the rule overlaps, duplicates, or conflicts with other Federal rules, and to the extent feasible, with State and local governmental rules.
- The degree to which technology, economic conditions, and other factors have changed to affect the Cotton Dust Standard.
- The nature of complaints and comments received by OSHA about the Cotton Dust Standard.

1. Continued Need for the Rule.[99]

Without regulation, workers would continue to face byssinosis risks. While most companies have complied with the Cotton Dust Standard, others continue to violate it, exposing workers to dangerous levels of dust.

[99] Regulatory Flexibility Act §610 (b) (1).

There is considerable data to support the continued need for the standard:

- A number of studies demonstrated a prevalence of 50,000 cases of byssinossis in the early 1970s and 12,000 in the late 1970s, numbers which were reduced to under 1,000 cases in the 1980s by the Cotton Dust Standard, as discussed in Chapter I and Chapter IV.2 of this report.

- Recent studies confirm the need for the standard. For example, a 1998 British study found that increasing exposure to cotton dust or endotoxin resulted in upper and lower respiratory tract symptoms, chronic bronchitis, and byssinosis.[100]

- A 1991 study suggests that a dust-related accelerated decline in the lung function of cotton textile workers occurs even on exposure at the 200 $\mu g/m^3$ meter PEL among yarn workers who smoke, further indicating the need to retain the standard.[101]

- Analysis of post-regulatory inspection and violation data from the OSHA Integrated Management Information System (IMIS) finds dozens of instances of overexposures at cotton textile facilities as discussed in Chapter IV. 3 of this report.

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[100] J. C. Simpson, R. M. Niven, C. A. Pickering, A. M. Fletcher, L. A. Oldham, and H. M. Francis, "Prevalence and Predictors of Work Related Respiratory Symptoms in Workers Exposed to Organic Dust," Occupational and Environmental Medicine, Vol. 555, No. 10, October 1998, pp. 668-672.

[101] H. W. Glindmeyer, et al., 1991.

- A 1997 NIOSH Health Hazard Evaluation Report[102] showed a continued need for the standard.

- Comments received in the 1998 OSHA Cotton Dust Docket support the success and effectiveness of the Cotton Dust Standard. (See the discussion below in "Comments to the Docket.")

a. Exposure to Cotton Dust Causes Byssinosis.

Exposure to cotton dust causes byssinosis. Many studies in the 1970s such as those by Merchant demonstrated a dose-response relationship between cotton dust exposure and byssinosis. (See the discussion in Chapter I.) The development and issuance of the OSHA Cotton Dust Standard led to reducing the prevalence of byssinosis from tens of thousands of cases in the 1970s to under 1,000 when the standard fully took effect. (See the discussion in Chapter IV.2.) Current studies confirm that exposures above the regulated levels will lead to increased respiratory disease, and no studies discredit these earlier findings. All commenters to OSHA (see page 47) agreed that the basic provisions of the Cotton Dust Standard remain necessary to protect the health of cotton textile workers. Clearly there is a continued need to retain the Cotton Dust Standard with its exposure limits and other requirements to protect the health of cotton textile workers.

b. Analysis of Post-Regulatory Inspection and Violation Data Shows Continued Risk.

An analysis of the compliance experience of the industries covered by the Cotton Dust Standard, using enforcement data from OSHA's IMIS database, further illustrates continuing need for the standard. Data from 1978 through 1998 reveal continued violations of the Cotton Dust Standard, especially in the 20-99 and 100-

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[102] C. K. Cook, "NIOSH Health Hazard Evaluation Report: HETA 97-0119-2707, Victoria Vogue, Inc., Bethlehem, Pennsylvania," U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 1997.

500 employee size categories. Workers continue to be exposed to excessive dust levels, especially in the 100-500-employee size firm, and there continue to be citations for violating other provisions of the standard. (These data are discussed in Chapter IV.3. and presented in Table 13.) Because there are continuing violations of the standard and the standard is needed to protect workers' health, weakening or elimination of the standard would likely lead to higher levels of cotton dust exposure and increased incidences of byssinosis in textile workers.

c. Comments From the Docket and Public Meetings Cite Continued Need and Effectiveness of the Rule.

Industry trade associations, union representatives, NIOSH, and other safety and health professionals and scientists submitted comments attesting to the success and effectiveness of OSHA's Cotton Dust Standard:

- The American Textile Manufacturers Institute (ATMI) stated that the Cotton Dust Standard has been effective in controlling and eliminating cases of byssinosis or "brown lung" from the textile workplace.[103]

- The National Association of Hosiery Manufacturers commented that the current standard serves the best interests of the industry and its employees.[104]

- The National Cotton Council (NCC) said that the OSHA Cotton Dust Standard has been, and continues to be, effective in controlling and eliminating cases of respiratory disease due to cotton dust generated in cotton processing workplaces covered by the standard.[105] At a Washington, DC

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[103] Moore, ATMI (OSHA Docket H-052 F, Exhibit 3-1).

[104] Comments of Sid Smith, President and CEO, National Association of Hosiery Manufacturers, August 27, 1998 (OSHA Docket H-052 F, Exhibit 3-4, p. 1).

[105] Comments of Dr. Phillip Wakelyn, NCC, submitted 1998 (OSHA Docket H-052F, Exhibit 3-5, p. 2).

public meeting, NCC's senior scientist, Dr. Wakelyn, stated that because of the good medical surveillance programs and controls, the NCC is not aware that any worker is getting chronic respiratory disease because of his/her exposure in cotton textile operations.[106]

- Two members of the Union of Needletrades, Industrial, and Textile Employees (UNITE), working with Fieldcrest, noted no new cases of byssinosis in the weave room since the early 1980s but recommended more routine inspections by OSHA to prevent employers from taking any "shortcuts" or "bending the rules for compliance."[107]

- A medical director from the Mount Sinai School of Medicine said that the Cotton Dust Standard has done much to contribute to worker safety and health in the textile industry, and that it represents the most effective way of maintaining the gains in worker health and safety established over the past two decades.[108]

Clearly there is a continuing need for the Cotton Dust Standard. The studies continue to demonstrate that it is necessary to protect worker health. Compliance data indicate that employees cannot rely on all employers voluntarily maintaining necessary protection and commenters agree on the need to keep the standard in effect.

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[106] Transcript of Washington Hearing, July 30, 1998 (OSHA Docket H-052 F, Exhibit 9-X, p. 18).

[107] Atlanta Transcript, July 24, 1998, pp. 5-11.

[108] Comments of Neil E. Schachter, Medical Director, Respiratory Therapy, Mount Sinai Medical Center, submitted August 29, 1998 (OSHA Docket H-052 F, Exhibit 3-2).

2. Complexity of the Rule.[109]

The Cotton Dust Standard is relatively short, with nine Code of Federal Regulation pages and some appendices. It follows the format of other OSHA health standards and has been used by the regulated community, a relatively small and stable group, which understands it well. The audience for the regulation is made up of professionals and those experienced in the cotton textile industry – not the average lay citizen or small business.

There are some technical concepts in the standard. However, those technical provisions, such as how to accurately measure cotton levels and perform and analyze lung function tests, are necessary for the accurate analysis and protection of worker health.

In its 1998 request for information in connection with this regulatory review, 63 FR 34140 (June 23, 1998), OSHA requested comments on whether the regulated community thought the standard too complex. OSHA did not receive any substantive comments criticizing the standard's complexity.

There were a few requests from commenters for interpretations on narrow issues. NIOSH asked for a few specific clarifications in comments sent to the OSHA Docket. (See Appendix X.) The National Cotton Council asked for clarification of the standard as it relates to a 1991 interpretive letter. However, in light of the standard's scientific nature, requests for technical clarification should be expected. The most effective and efficient way of answering requests for minor clarifications is through letters of clarification – not the extensive rulemaking process. OSHA's Directorate of Compliance Programs routinely responds to public requests for minor clarifications of Agency standards, which do not make substantive changes.

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[109] Regulatory Flexibility Act §610 (b) (3).

OSHA concludes that the rule is not too complex. That was the view of commenters as well. It is reasonably short, consistent with other OSHA health standards, and clearly specifies to the regulated community what needs to be done. Any attempts to change the style of the rule would likely create confusion, and would probably create new litigation as to the meaning of the standard. It also would not be a judicious use of OSHA's limited resources.

3. The Extent to Which the Rule Overlaps, Duplicates or Conflicts with Other Federal Rules, and, to the Extent Feasible, with State and Local Governmental Rules.[110]

The OSHA Cotton Dust Standard and the essentially identical standards adopted by the 23 States, which operate OSHA-approved state plans are the only rules that protect workers from the health effects of cotton dust. (States and local governments are precluded from adopting occupational safety and health standards absent an approved State Plan.) Included among the States which have chosen to operate State plans and adopt their own Cotton Dust Standard are the States, which are the most significantly impacted by the standard. There are no conflicting EPA, Department of Agriculture or any other Federal Agency rules that have a direct impact on the protection of workers from cotton dust related diseases.

Section 18 of the OSH Act provides the States the opportunity to assume responsibility for occupational safety and health standards adoption and enforcement through the submission and approval of a State Plan. State plans operate under authority of State law and are required to adopt standards equivalent to the Federal within 6 months of promulgation. State standards must be "at least as effective" and can be more protective than the Federal. Most of the cotton textile industry is located in States, which operate OSHA-approved state plans.

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[110] Regulatory Flexibility Act §610 (b) (4).

Although initially one or more of the state Cotton Dust Standards differed from the Federal and occasioned some controversy; all state standards are now essentially identical. OSHA is not aware of any current problems that have been caused by possible differences between the state plan cotton dust rules and the OSHA standard.

OSHA requested comments on whether the rule conflicts with other Federal or state regulations. Comments indicated that the OSHA Cotton Dust Standard does not overlap, duplicate, or conflict with any other Federal or state government regulation administered by other agencies.

The American Textile Manufacturers Institute and the National Cotton Council view the respiratory protection requirements in the Cotton Dust Standard as conflicting with the provision for powered air purifying respirators (PAPRs) in OSHA's revised Respiratory Protection Standard (29 CFR 1910.134). They recommend modifying the language in the Cotton Dust Standard to mirror the language in the Respiratory Protection Standard.

The Cotton Dust Standard permits employees required to wear respirators, because they work in areas with cotton dust levels above the exposure limit to choose to wear powered air purifying respirators (PAPRs) (1910.1043(f)(3)(ii)). PAPRs have advantages for employee protection. Face fit is not critical with these respirators, and they do not create breathing resistance. They may also be less difficult for employees to wear in the hot, humid atmosphere of most textile mills. PAPRs rely on a motor to force air through the filter, while negative pressure respirators rely on the employee's lungs to force the air through the filter.

The new Respirator Standard provides that employers are only required to provide PAPRs when a doctor or other qualified medical practitioner finds a medical condition that may place the employee at increased health risk from wearing a negative pressure respirator (1910.134(e)(6)(ii)). The new Respirator Standard is

designed to be general. When it was issued, OSHA stated that it was not designed to replace the respirator provisions in individual standards that were designed to meet the particular circumstance of a particular substance or industry, were appropriately more protective for a specific substance, and were adopted based on evidence in the record of that particular rulemaking.

The specific respirator provision of the Cotton Dust Standard referred to by commenters applies to workers exposed over the cotton dust exposure limit. The effect of cotton dust is to reduce lung function, which is likely to make it even more difficult for textile workers than other workers to draw air through a negative pressure respirator. Further, textile workers work in hot, humid atmospheres where wearing a negative pressure respirator is more difficult. OSHA concludes that it would be inappropriate to reopen the Cotton Dust Standard to propose a change under these circumstances.

4. The Length of Time Since the Rule Has Been Evaluated or the Degree to Which Technology, Economic Conditions and Other Factors Have Changed in the Areas Affected by the Rule.[111]

There have been extensive technological improvements incorporated into textile production since the time of consideration and publication of the Cotton Dust Standard. Because of major modernization of machinery, cotton textile workers in the U.S. today work with machines that are significantly more efficient and safer than ever before. According to the American Textile Manufacturers Institute (ATMI), the textile industry has seen many changes in the 20 years since the standard was written, and today has clean and high-tech facilities in addition to advanced ventilation systems and effective worker training and medical programs.[112]

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[111] Regulatory Flexibility Act §610 (b) (5).

[112] Moore, ATMI (OSHA Docket H-052 F, Exhibit 3-1).

a. There Are Many Improvements in Control Technologies.

By 1981, many textile machinery manufacturers had designed machinery that was enclosed more efficiently and allowed production at lower costs than before. The new designs combined processes, conveyed material via ducts or covered conveyers, and had integral enclosures and dust control hoods. Enclosing machinery and having dust control designed and built integrally into the machines is true of new automatic bale feeding equipment, opening and cleaning lines, chute fed cards, enclosed draw frames, combers, and roving frames. These new machines achieved dust control with lower energy costs and they removed contact between people and fibers while increasing productivity.[113] Controlling dust at its source by means of controls designed into production machinery is an integral part of plant modernization.

Cotton dust interferes with textile machinery operation as well as exposed workers' lung function. As machinery becomes more sophisticated and complex, textile companies find dust control essential to keep these new expensive machines from clogging and slowing production. The new machines are faster, and some processes entailing worker exposure have been totally eliminated. Also, processes are less dusty and noisy, and temperature and humidity are better controlled.[114]

A 1983 Office of Technology Assessment (OTA) – U.S. Congress report[115] found that innovative technology was being incorporated into the four major processes affecting productivity and dust levels in textile mills. In opening and picking, installation of automatic equipment was replacing manual opening. In the carding process, chute-fed cards replaced manual carding and most manual cleaning. In

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[113] H. S. Barr, "Modern Plant Dust Control Techniques," Chest, International Conference on Byssinosis, April 1981 (supplement), Vol. 79, No. 4, pp. 95S-105S.

[114] Ibid.

[115] Ruttenberg, OTA.

spinning, the conversion of some yarn from ring spinning to open-ended spinning was reducing exposure. Finally, a shift in weaving from shuttle to shuttleless looms further reduced dust levels. All these improved technologies had existed for at least a decade before the OSHA Cotton Dust Standard was published, but few had been used.

Other new technologies were generally adopted after the issuance of the Cotton Dust Standard. Many draw frames and roving frames were equipped with continuous waste removal systems, which reduce dust levels by continuously removing the waste and dust from the frames, transferring the waste to the bale automatically and the dusty air to a rotary drum filter. New combers are better enclosed than previously and the new short fiber removal systems require 77% less energy cost for collection and transportation to the waste house. Automatic pick-up and automatic baling of short fibers reduces dust levels and laborious tasks, and separates workers from dust sources. Also, an automatic waste removal system is now applied to bale opening equipment, feeders, cleaning equipment, cards, and other equipment.[116]

The development of modern chute feed systems represented a major technological advance. These modern chute feeds are pneumatic systems that handle the whole production process, from bale opening to carding, eliminating not only dust, but also the backbreaking task of manually feeding the lap into carding machines. These automated systems are enclosed, thereby reducing human contact with cotton dust. Air filtration suction systems are attached to the machinery at points where dust is generated.[117]

Many textile companies installed new high-speed carding machines and upgraded

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[116] Ibid.

[117] A. Field, 1984.

spinning technology as well, both of which concurrently reduced worker exposure to dust. Use of high speed carding machines reduced the total number of carding machines by more than one-third. The new machines handle 150 pounds of fiber per hour compared to 20 pounds for the older models. The new open-ended spinning machines cost more than the old ones, but are at least four times as productive. These machines also eliminate several earlier operations that created lint dust levels, in part because the new machines require a dust-free environment to work smoothly.[118]

According to a 1987 OTA report, in terms of output per person-hour, the U.S. textile industry is among the most productive in the world. The industry continues to modernize and invests billions of dollars per year in new plant and equipment. New technologies like water and air-jets have replaced shuttles; robots deliver material and splice yarn; computers design fabrics and lay pattern on the material; and advanced spinning methods as well as greater automation are used throughout the fabric formation process.[119]

This analysis shows that technological improvements have made it easier to control exposure to cotton dust and therefore easier to comply with the Cotton Dust Standard. Those technical improvements have also made the industry more productive. Although not part of OSHA's mission, in addition to improving worker health, there are some indications that the standard provided incentives for broad-based, productivity enhancing and modernizing investments.

The technical improvements clearly have not disadvantaged smaller firms. As discussed in Chapter V, at the same time as these technological advances were occurring, the number of very small textile firms, their employment, and their sales

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[118] Ibid.

[119] U.S. Congress, Office of Technology Assessment, U.S. Textile and Apparel Industry: A Revolution in Progress -- Special Report, OTA-TET-332, Washington, DC, U.S. Government Printing Office, April 1987.

were increasing.

b. The Industry Has Remained Economically Competitive.

A major economic change that has affected the cotton textile industry in the 1980s and 1990s has been the reduction of tariffs on imports and the phasing out of quotas on imports. The Multifiber Agreement has been phased out and replaced by various free trade agreements such as the Caribbean Basin Initiative, the North American Free Trade Agreement (NAFTA), and the World Trade Organization Agreement - Uruguay Round. (See the discussion in Chapter III. 3.)

Despite the reduction in trade protection for the U.S. textile industry, the value of shipments has progressively increased for the textile mill products sector, including the cotton-using sectors. From 1982 to 1998, sales of the major cotton-using four-digit SICs doubled. (See Tables 6 and 7.) The broadwoven cotton weaving, narrow fabrics weaving, and yarn spinning sectors of the cotton textile industry realized major gains in value of products shipped between 1982 and 1987 immediately after the Cotton Dust Standard took effect. The increase in the value of shipments between 1982 and 1992 approached 50% in one of the cotton-using sectors and was well above that in two other sectors. (See Table 6.)

The industry is profitable, productive, and growing. Throughout the 1990s, textile industry indicators have shown improvements.[120] The American Textile Manufacturers Institute's (ATMI's) 1997 Annual Business Review showed that both shipments and new orders increased.[121] After-tax profits for the U.S. textile industry were expected to reach $2.1 billion in 1998. Square yards produced per loom-hour increased nearly 15% from 1996 to 1997. Machine productivity in the woven sector increased almost 150% from 1988 to 1997 to nearly 35 square yards

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[120] Environmental Protection Agency, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," September 1997.

[121] ATMI, Office of the Chief Economist, "The U.S. Textile Industry, Scope and Importance," Washington, DC, 1996, as cited in Environmental Protection Agency, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," September 1997.

per loom-hour in 1997.[122]

ATMI's 1998 Annual Business Review showed that textile corporate profits remained firm at nearly $2 billion.[123] Net sales and profits increased between 1995 and 1998 on an individual establishment basis for SIC 22, although there were large fluctuations among the 4 digit SICs. (See Table 19.) Between 1996 and 1998, sales for the six major cotton-using SICs increased by over 4%. (See Table 7.) Total sales in these six sectors increased by more than 7.5% for small businesses. There was a 66% increase in sales for the smallest size firms (1-19 employees) and sales for the 20-99 employee size firms increased by 29% during the same period. (See Table 7.) These data indicate that despite the reduction in tariffs and quota protection, small businesses in the cotton textile sector remained competitive.

Productivity increased at an annual rate of 2.5% between 1972 and 1979 and increased at a rate of 3.5% from 1979-1991 after the standard was published.[124] Productivity in the textile industry continues to improve. The balance of trade is negative, but exports continue to expand. Investment in plant and equipment is increasing. There are no indications that the Cotton Dust Standard has had a negative economic impact on the industry generally or on the smaller businesses in the industry. In fact, there are some indications that the standard provided incentive for broad-based, productivity enhancing, and modernizing investments.

5. The Nature of Complaints and Comments Received Concerning the Rule.[125]

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[122] Ibid.

[123] American Textile Manufacturing Institute News Release, "Low-Cost Asian Exports Put Pressure on U.S. Market; NAFTA Exports Remain Strong," December 8, 1998, http://www.atmi.org/newsroom/releases/ pr199843.html, downloaded February 3, 1999.

[124] M. Jablonski, "Multifactor Productivity, Cotton and Synthetic Broadwoven Fabrics," Monthly Labor Review, July 1995, pp. 29-30.

[125] Regulatory Flexibility Act §610 (b) (2).

Section 610 of the Regulatory Flexibility Act requires OSHA to evaluate public comments and complaints received on a rule. To meet these requirements, OSHA published a Federal Register Notice requesting comments on the Cotton Dust Standard (63 FR 32140, June 23, 1998), and held two public meetings in Atlanta and Washington, DC. OSHA opened Docket H-052F to store information gathered from affected persons about their experience with the rule and to obtain comments on any material changes in circumstances since issuance of the rule.

Members of the Union of Needletrades, Industrial & Textile Employees (UNITE) (the trade union representing textile workers), industry trade association representatives, and expert professionals delivering occupational safety and health services to workers provided strong, general support for the standard. (For general comments on the success and effectiveness of OSHA's Cotton Dust Standard, see "Comments from the Docket and Public Meetings in Section 1 of this chapter at footnotes 103-108.)

Comments and Recommendations on Specific Issues.

Although the comments received in the docket and at the public meetings supported the overall need to retain the standard and its effectiveness, some of the commenters suggested amendments or interpretations to the standard to focus on seven narrow issues -- washed cotton, extended shifts, respirators, monitoring, medical surveillance, PELs, and training.

a. **Washed Cotton.**

Experimental research over the years has demonstrated that washing cotton using certain processes, and following certain protocols (as to temperature, water volume, grade of cotton, etc.), reduces or eliminates the likelihood that the dust from the washed cotton will cause byssinosis. It is postulated that the washing reduces the likelihood that cotton dust will cause byssinosis by washing out that part of the dust, which is the causative element.

However, certain washing processes have not been very effective in reducing the likelihood that the cotton dust would cause byssinosis and other washing processes have made the washed cotton too difficult to process into textiles.

In 1980 the Washed Cotton Task Force was created with representatives from government, industry, and unions to develop and test washing processes that would reduce the risk of byssinosis and be practical for processing. The National Institute for Occupational Safety and Health (NIOSH) performed much of the research for the Task Force. The reports of that Task Force led to the provisions in the 1985 amendments to the Cotton Dust Standard, which reduced regulation on the processing of the cotton that had been washed in certain ways. (See the discussion at 50 FR 51161-51164 (December 13, 1985), and 29 CFR 1910.1043(n)).

The Task Force continued research after 1985. In 1995 NIOSH issued "Current Intelligent Bulletin No. 56, WASHED COTTON," which presented the Task Force recommendation that cotton washed by an additional process, batch kier washing, receive partial exemption from the Cotton Dust Standard.[126] NIOSH[127] and the National Cotton Council[128] both officially supported this recommendation.

OSHA has preliminarily reviewed the Task Force report. That review indicates that use of the batch kier process following the protocol recommended by the Task Force substantially reduces the likelihood that the dust generated from cotton washed in that manner will cause byssinosis. Accordingly, OSHA intends to propose adoption of the recommendation of the Task Force.

b. **Respirators**.

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[126] OSHA Docket H-052F, Ex. 3-5E.

[127] OSHA Docket H-052F, Ex. 3-3.

[128] OSHA Docket H-052F, Ex. 3-5.

Two respirator issues were raised by the comments: protection factors for PAPRs and permitting employees wearing respirators to remain in blow-off areas.

(i) Protection Factors

The current standard permits the use of powered air-purifying respirators (PAPRs) equipped with high-efficiency particulate filters at cotton dust exposures greater than 100 times the applicable PEL. NIOSH recommends that an assigned protection factor (APF) of 25 be used on PAPRs with particulate filters. NIOSH recommends use of an APF of 50 for PAPRs equipped with a tight-fitting face piece and a high efficiency particulate filter.[129]

OSHA is currently engaged in a rulemaking to set protection factors for respirators generally. As part of the rulemaking, OSHA is considering appropriate protection factors for various types of PAPRs. NIOSH is participating in that rulemaking. OSHA believes it is a better use of regulatory resources to resolve protection factors issues in the ongoing rulemaking on that issue.

[129] Comments of Paul Schulte, Director, Education and Information Division, National Institute for Occupational Safety and Health, submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-3).

(ii) Use of Respirators During Blow-Down/Blow-Off Operations

The current language in the standard[130] does not allow employees to stay in "blow-down" and "blow-off" areas unless their presence is absolutely necessary. The American Textile Manufacturers Institute (ATMI) believes that the language of the standard should be changed to allow employees who wear suitable respirators to stay in the work areas during such operations.[131] ATMI believes that as long as employees are fitted with appropriate respirators, they are adequately protected. ATMI believes that this change, by decreasing stops in production, would reduce costs. Textile workers testified that dust levels become very high during blow-down and blow-off and that remaining in the area would lead to substantial over-exposure to employees.

The 1985 preamble reviews the issue at length, and discusses many comments.[132] The language OSHA adopted was based on negotiated identical recommendations made by the ATMI and the Amalgamated Clothing and Textile Workers Union (ACTWU), a predecessor of UNITE.

OSHA concludes that it would be inappropriate to propose to change a provision that was based on extensive comments and consideration and the identical recommendations of the industry and union. Much more extensive comments, evidence, and a wider consensus of views would be needed before it would be appropriate to propose changing these provisions.

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[130] Section 1910.1043(g)(1) states: "Compressed air "blow-down" cleaning shall be prohibited where alternative means are feasible. Where compressed air is used for cleaning, the employees performing the "blow-down" or "blow-off" shall wear suitable respirators. Employees whose presence is not required to perform "blow-down" or "blow-off" shall be required to leave the area affected by the "blow-down" or "blow-off" during the cleaning operation."

[131] Moore, ATMI (OSHA Docket H-052 F, Exhibit 3-1).

[132] See 50 FR 51141-2, 51156.

c. **Monitoring**.

Two exposure monitoring issues arose during the 1998 review -- the required frequency of air monitoring and rules on alternative sampling devices:

(i) Frequency of Air Sampling.

Both ATMI and the National Cotton Council (NCC) recommend that instead of annual air sampling, as required in 1910.1043 (d)(3)(i),[133] testing should be allowed every two years for areas below the action level. ATMI states: "We believe annual testing in areas below the action level is not necessary and costly."[134] NCC comments that annual monitoring for those areas that are at or below the action level "is not necessary and is an unneeded cost," and that "this is consistent with other parts of the Cotton Dust Standard where OSHA has reduced requirements when exposures are at or below the action level."[135]

ATMI believes that frequent sampling in areas below the action level is unnecessary since the standard also requires maintenance and verification of mechanical ventilation systems and the newer computer controlled filtration systems automatically make adjustments to ensure proper working conditions. NCC agrees with ATMI and comments, "if proper maintenance and verification systems are in place, there is no need to perform sampling in areas below the cotton dust action level more frequently than every two years." Both ATMI and NCC agree that employers should conduct sampling whenever there is a change in production, processes, or controls used – as the standard currently mandates.

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[133] Section 1910.1043(d)(3)(i) states: "[i]f the initial monitoring required by paragraph (d)(2) of this section or any subsequent monitoring reveals employee exposure to be at or below the permissible exposure limit, the employer shall repeat the monitoring for those employees at least annually."

[134] Moore, ATMI, (Docket H-052F, Ex 3-1, p. 2).

[135] Comments of Dr. Phillip Wakelyn, NCC, submitted 1998 (OSHA Docket H-052F, Exhibit 3-5, p.2).

Again, this was a controversial issue in both the 1978 and 1985 rulemakings.[136] In that rulemaking, NIOSH, Dr. James Merchant and Dr. Morton Corn objected to eliminating monitoring when exposures were below the action level on the grounds that exposure variability was such that there was a substantial probability that employees initially exposed below the action level would subsequently have exposures above the action level. In addition, ATMI and ACTWU made identical recommendations that OSHA adopt the current language. (See the discussion under Subsection b. ii, above.)

OSHA concludes that it would be inappropriate to propose to change language that was adopted based on extensive evidence, comments, and the identical recommendations of the affected industry and union. No data were submitted to support the proposed change. Supporting data and a more extensive and wider consensus of views would be needed before it would be appropriate for OSHA to spend its limited regulatory resources to propose changing this provision.

(ii) Alternative Sampling Devices

Section 1910.1043(d)(l)(iii)(A) of the standard permits the use of an alternative sampling device if "it collects respirable particulates in the same range as the vertical elutriator (approximately 15 microns)."

NIOSH suggests that this language be changed as follows: "It collects thoracic respirable particulates in the same range as the vertical elutriator (approximately 15 microns) or other sampler with 50% sampling efficiency at approximately 10 micrometers aerodynamic equivalent diameter."[137] According to NIOSH, such a change would make the language of the standard more consistent with the language used by the American Conference of Governmental Industrial Hygienists. NIOSH

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[136] See the discussion at 50 FR 51151, December 13, 1985.

[137] Schulte, NIOSH, (OSHA Docket H-052F, Ex.3-3, p.1).

also recommends that OSHA change the term "respirable particulates" to "thoracic particulates" throughout the standard.

OSHA concludes that although NIOSH's suggestions may be valid technical points, they are not sufficiently important to utilize the Agency's limited regulatory resources to make these relatively slight adjustments.

d. **Medical Surveillance**

All employees exposed to cotton dust covered by the Cotton Dust Standard are required to be provided with medical surveillance. (See 1910.1043(h), and appendices B, C, and D.) A major reason why the standard has succeeded in reducing byssinosis is its medical surveillance requirements.

No commenters suggested that the medical surveillance provisions be eliminated. But NIOSH, NCC, and ATMI made a number of suggestions for technical changes to the medical surveillance provisions based on more recent medical information. NCC and ATMI also proposed elimination of the medical surveillance requirements or a reduction in its frequency for certain groups of employees. (These suggestions are presented at considerable length in Appendix X, Section 4 following and in Exhibits 3-1, 3-3, and 3-5.)

OSHA may only change the medical surveillance provisions of a standard after a rulemaking pursuant to Section 6(b)(7) of the OSH Act. Changes in medical surveillance generally require considerable study and review by appropriate experts. Consequently, making detailed changes to the medical surveillance provisions would require considerable OSHA resources. Although OSHA believes that a number of NIOSH's medical surveillance recommendations might improve the effectiveness of the standard somewhat, the Agency believes, in light of the fact that the existing medical surveillance provisions have proved to be effective in protecting worker health, that it is not urgent to propose changes to the medical surveillance provisions at this time.

The changes that NIOSH recommends include updating the tables used for analyzing spirometery results (breathing function), changing the timing of spirometry tests and providing more specific guidance on what constitutes significant change in spirometry results. ATMI and NCC make somewhat different recommendations in this area.

NCC recommends reducing the frequency of medical examinations in certain circumstances. Because byssinosis is a progressive disease, OSHA believes that substantial medical research and opinion would need to be available before a judgment on the appropriateness of such a changes could be made. The limited information supplied to OSHA in the course of this regulatory review is not sufficient to propose making these changes at this time.

ATMI recommends that OSHA exempt from coverage by the standard's medical surveillance provisions, several groups of textile workers who have limited exposure to cotton dust. However, the rulemaking record contains evidence that a meaningful percentage of workers have an acute and severe reaction to cotton dust after only a brief exposure to low levels. Accordingly, in the absence of a substantial body of medical research (which was not presented in the course of this regulatory review) OSHA does not consider it appropriate to propose this change at this time.

e. **Exposure Limit Issues**

NIOSH raised two issues about the standard's exposure limits, the protectiveness of the standard for yarn workers who smoke, and interpretations of the limit for workers who work shifts longer than eight hours.

(i) The Exposure Limit for Yarn Manufacturing

Two studies by Glindmeyer, et al.[138] indicate greater than predicted chronic declines in lung function in current employees who work in yarn manufacturing, where the permissible exposure limit (PEL) is an 8-hour TWA of 200 $\mu g/m^3$. Based on these studies, NIOSH recommends that, "OSHA should review new information in preparation for the possibility of developing a revised PEL to protect all workers exposed to cotton dust."[139]

When OSHA issued the 200 $\mu g/m^3$ limit for yarn preparation in 1978 it predicted that there would be a remaining risk of byssinosis at that PEL. However, there were feasibility constrains on setting a lower limit. Byssinosis rates have been lower than predicted at that time because of the effectiveness of medical surveillance and the other provisions of the standard.[140]

The review of data to consider the possibility of a lower exposure limit would require not only a review of the health studies, but a major exercise in developing and reviewing the feasibility information. OSHA does not believe that reopening the record for this reason would be an appropriate use of its scarce regulatory resources.

(ii) Extended Work Shifts

When OSHA issued the cotton dust PELs in 1978, the eight-hour workday was common in textiles and in most industries. The cotton dust PELs were expressed as eight-hour time weighted averages (TWAs), as are virtually all OSHA PELs. For example the PEL for yarn preparation is an eight-hour TWA of 200 $\mu g/m^3$.

For their own convenience, some firms in the textile industry have adopted

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[138] H. W. Glindmeyer, et al., 1991, pp. 675-683 and H. W. Glindmeyer, et al., 1994, pp. 584-590.

[139] OSHA Docket H-052F, Ex. 3-3, p. 1.

[140] See the discussion in Chapter IV.

twelve-hour shifts. For those firms, it is common for employees to work three, twelve-hour days in one week and four twelve-hour days in the second week as their typical work pattern.

This has raised the interpretive issue of what, if any, adjustments to the exposure limit should be made to take into account this work pattern, especially in yarn preparation. Any employee working a twelve-hour day and exposed to an airborne concentration of 200 $\mu g/m^3$would inhale substantially more cotton dust per shift than an employee working an eight-hour shift and exposed to the same concentration.

NIOSH has sponsored some animal research that it believes is an accurate model of human response on this issue.[141] Based on this research, NIOSH stated that "these acute pulmonary responses exhibited a linear dependence on total exposure (i.e., the product of dose x duration), suggesting that the current PEL for eight-hour work shift is inadequate for extended work shifts, and should be lowered in relationship to the extra hours worked during a given day."[142]

After the hearings and close of the comment period for this Section 610 Review, a preliminary article on this topic but with a different focus, was published.[143] OSHA also received a late comment from the Union of Needletrades, Industrial and Textile Employees (UNITE) stating that exposure levels should be reduced for extended work shifts to protect worker health and that it was feasible for

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[141] V. Castranova , V. A. Robinson, W. T. Goldsmith, N. A. Phillips, A. Afshari, and D. G. Frazer, "Cotton and Other Organic Dusts: Time Course of Pulmonary Responses to Inhalation of Cotton Dust in the Guinea Pig Animal Model", Journal of Cotton Science 2:10-16, [1998a] and V. Castranova , V. A. Robinson, W. T. Goldsmith, N. A. Phillips, A. Afshari, D. G Frazer, "Pulmonary inflammation of guinea pigs in response to inhalation of cotton dust: effect of extended exposure day", In: Wakelyn PJ, Jacobs RR, eds. Proceedings of the 22nd Cotton and Organic Dusts Research Council. Memphis, TN: National Cotton Council, [1998b].

[142] OSHA Docket H-052F, Ex. 3-3, p.1.

[143] R. Jacobs and B. Boehlecke, "Evaluation of the Effects of 12 hour Workshifts on the Pulmonary Function of Cotton Textile Workers," Proceedings of the 23rd Cotton Dust Research Conference, National Cotton Council, 1999.

textile industry employers to do so.

Longer work shifts also create enforcement problems for OSHA. It is very difficult for a compliance officer to monitor a worker over a twelve-hour day and virtually impossible to do so over a two-week period. Attempting to do the latter would greatly reduce the number of inspections OSHA could perform.

Two people testified at the public meeting that there were some inconsistencies among the states and federal OSHA on their interpretations of the exposure limit for extended shifts. The first was Mr. Little, a textile worker at Fieldcrest.[144] The second was Mr. Lopez, an industrial hygienist, who works for the industry but was testifying as a private person.[145] Mr. Lopez said he wasn't sure it was necessary to adjust exposure if there was a longer shift.[146] Both testified how difficult it can be to wear respirators for a full shift, especially for a twelve-hour shift.[147]

OSHA intends to review the issue of the appropriately protective and feasible PEL for extended shifts carefully. Based on this review, including consultation with the affected states, OSHA intends to issue any clarification that may be needed and ensure that any interpretations are consistent with the provision of the necessary health protection.

f. Frequency of Training.

The Cotton Dust Standard requires initial training and annual retraining of

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[144] OSHA Docket H-052-F, Atlanta transcript p. 8.

[145] Ibid., p. 13.

[146] Ibid., p.15.

[147] Ibid., pp. 7, 14-15.

workers exposed to cotton dust on the hazards it presents, how to avoid high exposures, the use of respirators and the purposes of medical examinations.[148] The National Cotton Council commented that it believed annual retraining is not needed.[149]

OSHA recently revisited the issue of the frequency of retraining when it updated the Respirator Protection Standard. It concluded in that rulemaking that annual retraining was necessary to assist workers in using respirators protectively.[150] The testimony of the two textile workers at the public meeting indicates that at least some textile mills have areas where controls are not being effectively utilized, where exposures are relatively high, and where respirators are required to be used.[151] Clearly these employees need to be able to recognize these situations, take necessary actions within their control and wear respirators effectively. In light of these circumstances, OSHA believes it is reasonable to maintain the Cotton Dust Standard's annual retraining requirements.

g. Comments Related to Small Business

The comments and testimony OSHA received by and large were directed at the regulated industries generally. They were not specifically directed at smaller as opposed to larger firms.

Phillip Wakelyn of the National Cotton Council stated that adding batch-kier washed cotton to the standard's partial exemption would benefit smaller firms. (As discussed under Subsection a. above, OSHA is seriously considering implementing this suggestion.)

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[148] 29 CFR 1910.1043(i).

[149] OSHA Docket H-052F, Ex. 3-5, p. 4.

[150] 63 FR 1261, January 8, 1998.

[151] OSHA Docket H-052 F, Atlanta transcript, pp. 5-10.

Dr. Wakelyn also stated that most waste processing, cottonseed processing, and garnetting firms are small. (See also the discussion in Appendix V.) He said that reducing the frequency of medical surveillance would be beneficial to them financially. He believed that the current, every two-year frequency of medical examinations was more frequent than medically necessary. However, Dr. Wakelyn stated that he had not reviewed the data supposedly supporting this assertion in detail.[152]

OSHA's views on amending the medical surveillance provisions of the standard are discussed above in Subsection d. If OSHA decides to reexamine that issue, it will consider Dr. Wakelyn's suggestion. However, because detailed evidence supporting such a change in frequency has not been submitted to OSHA, OSHA is in no position to consider whether it would be appropriate to propose this change. This is particularly true because the medical surveillance provisions of the Cotton Dust Standard have proved to be so successful in reducing byssinosis rates.

[152] OSHA Docket H-052F, Washington, DC transcript, pp. 29-30.

CHAPTER VII

Executive Order 12866

Review of the Standard

President Clinton signed Executive Order 12866 on Regulatory Planning and Review in September 1993. Agencies of the Federal government must review their existing significant rules and determine whether any such regulations should be modified or eliminated to make the Agency's regulatory program more effective in achieving the regulatory objectives, less burdensome, or in greater alignment with the President's priorities and principles set forth in the Executive Order. (See Appendix II.) This review focuses on four major points within applicable law:

1. Whether the standard has become unjustified or unnecessary as a result of changed circumstances;
2. Whether standards are compatible with each other and not duplicative or inappropriately burdensome in the aggregate;
3. Whether the standard is consistent with the President's priorities; and
4. Whether the effectiveness of the standard can be improved.

This review of the OSHA Cotton Dust Standard, pursuant to Executive Order 12866, finds that the Cotton Dust Standard is necessary to protect worker health, is not duplicative of other regulations, is not inappropriately burdensome, is consistent with the President's priorities and is highly effective. Chapter VI identifies some narrow areas such as washed cotton, where amendments might improve this already highly effective standard.

1. Whether the Cotton Dust Standard Has Become Unjustified or Unnecessary as a Result of Changed Circumstances.

The health risk to workers associated with overexposure to cotton dust remains unchanged. Exposure to cotton dust still causes byssinosis. Some textile plant operations still expose workers to dangerous levels of cotton dust. The Cotton Dust Standard remains both justified and necessary. Many comments support continuing the standard in its present format since it has been successful in protecting workers from the hazards of cotton dust exposure. (See this entire report, but in particular Chapter I, Chapter IV.2. and Chapter VI.1.)

2. Whether the Cotton Dust Standard is Compatible with Other Regulations and Not Duplicative or Inappropriately Burdensome in the Aggregate.

The Cotton Dust Standard is compatible with other OSHA standards. It is not duplicative of other standards or regulations. (See Chapter VI. 3.) It is not inappropriately burdensome in the aggregate. The economic condition of the textile industry has remained healthy, with growing sales and continued profits. (See Chapters III, V, and VI. 4b.) The standard has encouraged the industry to improve its technology and become more productive. (See Chapter VI. 4.a.)

3. Whether the Cotton Dust Standard is Consistent with the President's Priorities.

The Cotton Dust Standard is consistent with the President's priorities. In 1970, concerned about the high rates of deaths, injuries, disabilities, and diseases associated with the workplace, Congress passed the Occupational Safety and Health Act (OSH Act). The OSH Act was passed by a bipartisan Congress "... to assure so far as possible every working man and woman safe, healthful working conditions and to preserve our natural resources." OSHA was created to develop

mandatory job safety and health standards and enforce them effectively. Controlling byssinosis was among the specific concerns of the Congress, as reflected in the legislative history of the Act.

The objective of Executive Order 12866 is to reform, and make more efficient, the regulatory process. The regulatory process must be consistent with the President's priorities to enhance planning and coordination with respect to both new and existing regulations; to reaffirm the primacy of Federal agencies in the regulatory decision-making process; to restore the integrity and legitimacy of regulatory review and oversight; and to make the process more accessible and open to the public.

There are more than 100 million Americans in the workforce today. It is the President's priority that these workers' occupational health be protected. Protecting health also requires promulgating rules that provide ongoing worker protection in a constantly changing work environment. The rules need to be reviewed periodically, written in plain language, and should allow flexibility to employers to continue to reduce hazards and avoid injury and illness as the workplace evolves. The Cotton Dust Standard has been consistent with such priorities by greatly reducing byssinosis cases in textile workers, and has enabled employers to comply with the standard, while developing and implementing new technology not only to reduce cotton dust exposures, but also to improve their productivity and profits.

4. Whether the Effectiveness of the Cotton Dust Standard Can Be Improved.

To date, the Cotton Dust Standard is extremely effective. The textile industry is in substantial compliance with the standard and most modern textile workplaces are clean, well ventilated, and less noisy. Comments and testimony submitted for

this regulatory review of the Cotton Dust Standard by representatives of textile trade associations, union members, and safety and health professionals and scientists confirm that the Cotton Dust Standard has been very successful in achieving its goal – reducing cases of byssinosis, a debilitating disease, in workers exposed to cotton dust. (See Chapter VI.1.) Studies indicate that the standard has substantially reduced the prevalence of byssinosis in the U.S. cotton textile industry. (See Chapter IV.2.) The majority of cotton textile manufacturers now meet the established dust level requirements of the OSHA standard. (See Chapter IV.1.)

An analysis of compliance and enforcement data reveals that there are still some workplaces with cotton dust levels in excess of the required PELs and the action levels. (See Chapter IV.3.) Enforcement activities need to be continued to maintain compliance with the standard.

The effectiveness of the standard may be improved by authorizing the use of an additional cotton washing process to receive partial exemption from the standard. (See Chapter VI.5.a.) As resources permit, OSHA intends to propose amending the standard to permit use of cotton washed via this process, to qualify for partial exemption from the standard.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

This review of the OSHA Cotton Dust Standard, conducted pursuant to Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order (EO) 12866 on Regulatory Planning and Review, finds a continued need for the standard. No significant negative impacts of the standard on small businesses or, in fact, businesses of any size, were identified. The industry is more productive than it was a generation ago.

The Cotton Dust Standard is effective in reducing disease and death among cotton textile workers. Trade associations, employee-representatives, and safety and health professionals alike agree that the Cotton Dust Standard is effective. The American Textile Manufacturers Institute and the National Cotton Council state that the standard is effective in eliminating and controlling cases of byssinosis.

There are many fewer cases of byssinosis since promulgation of the standard. A number of studies report that the textile industry is largely in compliance with the standard and that the standard is effective in protecting workers. In fact, there is evidence that by investing in new and more technologically advanced equipment, the industry achieved enhanced productivity and improved economic health as well as improved health for its workers.

Overall, small businesses in the textile industry have done well since the onset of the standard, especially the smallest businesses. The smallest cotton textile establishments rose in number from 1977 to 1992 -- those with 1 to 19 employees by 43% and those with 19-99 employees by 25%. Small businesses -- those with fewer than 500 employees, which approximates the SBA category -- make up 93% of the cotton textile establishments. Sales and profits of smaller and larger companies have increased since the issuance of the standard.

1. The Standard is Justified and Necessary: There is a Continuing Need For It.

Unchecked exposure to cotton dust would still cause byssinosis among cotton textile workers. While a large part of the cotton textile industry has been successful in providing effective protection to its workers against cotton dust, some textile plant operations still expose workers to excessive levels of cotton dust. Comments to the Docket and at public meetings also support the continuance of the standard and indicate that the Cotton Dust Standard remains both justified and necessary to provide the required protection for workers from the hazards of cotton dust exposure -- something the standard accomplishes by requiring institution of essential dust control, medical monitoring and other necessary practices at the workplace.

2. Some Comments From the Public Suggest Technical Amendments.

Some commenters suggested that it would be appropriate to amend the standard to allow a partial exemption for cotton washed by the batch-ker process. OSHA intends, as resources permit, to propose amending the standard to implement this recommendation. A number of technical changes to the medical surveillance provisions suggested by commenters may also have merit – but in light of the success of the existing medical provisions in protecting workers, making these changes is not a high regulatory priority for OSHA at this time.

3. The Standard is Not Overly Complex or Inappropriately Burdensome.

There were no substantial comments that the standard was overly complex or placed an inappropriate burden on the industry, or in particular on small business.

4. The Standard is Compatible with Other Regulations.

The evidence indicates that the standard is compatible with other regulations. Only two areas of possible overlap with other standards arose and they concerned the Respirator Standard. As discussed above in Ch.VI.3., OSHA considers the Cotton Dust Standard's provision on when an employee can choose a powered air purifying respirator more appropriate for the textile industry than the provision in the Respirator Standard. OSHA considers the question of a protection factors more appropriately in the ongoing rulemaking on that topic. However, as stated earlier in Ch.VI.5.b., OSHA intends to establish APFs for various types of respirators, including PAPRs, in an ongoing rulemaking on this issue.

5. Technology in the Textile Industry Has Advanced; The Economic Condition of the Industry is Strong.

Technological and economic improvements within the textile industry primarily resulted from a massive modernization program of the industry's antiquated machinery, spurred on by foreign competition and the OSHA Cotton Dust Standard. Cotton textile workers in the U.S. today work with machines that are significantly more efficient and safer than ever before.

According to ATMI, the textile industry has seen many changes in the 20 years since the standard was written and today has high-tech facilities characterized by advanced ventilation systems and effective worker training and medical programs. The textile industry in 1998 is more modern and more productive than it was in

1978. While new production processes are less labor intensive, wages are increasing. Sales are increasing in the industry and it remains profitable. The number of very small firms is increasing.

Table 1

Standard Industrial Classifications (SICs) Within the Textile Industry (SIC 22)

3-Digit SIC code		4-Digit SIC code	
SIC 221	Broadwoven Fabric Mills, Cotton	SIC 2211	Broadwoven Fabric Mills, Cotton
SIC 222	Broadwoven Fabric Mills, Manmade Fiber and Silk	SIC 2221	Broadwoven Fabric Mills, Manmade Fiber and Silk
SIC 223	Broadwoven Fabric Mills, Wool (Including dyeing and finishing)	SIC 2231	Broadwoven Fabric Mills, Wool (including dyeing and finishing)
SIC 224	Narrow Fabric Mills: Cotton, Wool, Silk, and Manmade Fiber	SIC 2241	Narrow Fabric Mills: Cotton, Wool, Silk, and Manmade Fiber
SIC 225	Knitting Mills	SIC 2251	Women's Full-Length and Knee-Length Hosiery, except socks
		SIC 2252	Hosiery, NEC
		SIC 2253	Knit Outwear Mills
		SIC 2254	Knit Underwear and Nightwear Mills
		SIC 2257	Weft Knit Fabric Mills
		SIC 2258	Lace and Warp Knit Fabric Mills
		SIC 2259	Knitting Mills, not elsewhere classified
SIC 226	Dyeing and Finishing Textiles, except wool fabrics and knit goods	SIC 2261	Finishers of Broadwoven Fabrics of Cotton
		SIC 2262	Finishers of Broadwoven Fabrics of Manmade Fiber and Silk
		SIC 2269	Finishers of Textiles, NEC
SIC 227	Carpets and Rugs	SIC 2273	Carpets and Rugs
SIC 228	Yarn and Thread Mills	SIC 2281	Yarn Spinning Mills
		SIC 2282	Yarn Texturizing, Throwing, Twisting, and Winding Mills
		SIC 2284	Thread Mills
SIC 229	Miscellaneous Textile Goods	SIC 2295	Coated Fabrics, not rubberized
		SIC 2296	Tire Cord and Fabrics
		SIC 2297	Non Woven Fabrics
		SIC 2298	Cordage and Twine
		SIC 2299	Textile Goods, NEC

Source: Office of Management and Budget, Standard Industrial Classification Manual, Washington, DC, 1987.

Table 2

U.S. Largest Textile Companies By 1995 Sales

Rank	Company	1995 Sales[1] (millions of dollars)	3-digit SIC code[2]	Industry SIC Code Description	Number of Employees
1	Springs Industries, Fort Mill, SC	$2,233	221	Broadwoven Fabric Mills, Cotton	17,500
2	Burlington Industries, Greensboro, NC	$2,209	223	Broadwoven Fabric Mills, Wool (Including dyeing and finishing)	18,900
3	WestPoint Stevens, West Point, GA	$1,650	221	Broadwoven Fabric Mills, Cotton	16,900
4	Unifi, Greensboro, NC	$1,555	228	Yarn and Thread Mills	6,400
5	Dominion Textile, New York, NY	$1,429	221	Broadwoven Fabric Mills, Cotton	
6	Collins & Aikman Corp., Farmville, NC	$1,291	221	Broadwoven Fabric Mills, Cotton	15,900
7	Triarc, New York, NY	$1,128	221	Broadwoven Fabric Mills, Cotton	1,880
8	Fieldcrest Cannon, New York, NY	$1,095	221	Broadwoven Fabric Mills, Cotton	13,926
9	Cone Mills, Greensboro, NC	$910	221	Broadwoven Fabric Mills, Cotton	6,200
10	Guilford Mills, Greensboro, NC	$783	225	Knitting Mills	6,836

Source: This chart has been adapted from data in *Fairchild's Textile & Apparel Financial Directory*, 1996, with assistance from ATMI.

[1] Sales figures include those of subsidiaries and operations (even those not related to textile industry).
[2] Each company was assigned a 3-digit SIC code that most closely resembles the firm's principal industry using *Ward's Business Directory of U.S. Private and Public Companies*.

Sources: Environmental Protection Agency, Office of Compliance, Office of Enforcement and Compliance Assurance, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," Table 4, p. 8, EPA/310-R-97-009, September 1997; and employment size for companies from Standard and Poor's, *Register of Corporations*, 1999.

Table 3

Geographic Distribution of Textile Mills in the United States

3-digit SIC code	Industry SIC Code Description	Major states (based on employment)	Approximate % of employment in 3-digit SIC category, attributable to major states
SIC 221	Broadwoven Fabric Mills, Cotton	AL, GA, NC, SC	87%
SIC 222	Broadwoven Fabric Mills, Manmade Fiber and Silk	GA, NC, SC,VA	79%
SIC 223	Broadwoven Fabric Mills, Wool (Including dyeing and finishing)	GA, ME, NC, VA	69%
SIC 224	Narrow Fabric Mills: Cotton, Wool, Silk, and Manmade Fiber	NC, PA, RI, SC	52%
SIC 225	Knitting Mills	GA, KY, LA, NC, NJ, NY, PA, TX	40%
SIC 226	Dyeing and Finishing Textiles, except wool fabrics and knit goods	GA, NC, NJ, SC	63%
SIC 227	Carpets and Rugs	GA	64%
SIC 228	Yarn and Thread Mills	GA, NC, SC	70%
SIC 229	Miscellaneous Textile Goods	AL, GA, MA, NC, NY, OH, SC, TN,	40%

Source: Adapted from various 1992 *Census of Manufactures, Industry Series*, for SICs 2211 - 2299, U.S. Department of Commerce, Bureau of the Census, 1995.

Source: Environmental Protection Agency, Office of Compliance, Office of Enforcement and Compliance Assurance, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," Table 3, p. 7, EPA/310-R-97-009, September 1997.

Table 4

Number of Firms and Establishments Using Cotton in the Yarn Preparation and Weaving Sectors 1977 and 1992

SIC	Description	Total Number of Firms		Total Number of Establishments		Percent of Establishments Using Cotton in 1977	Number of Establishments Using Cotton	
		1977	1992	1977	1992		1977	1992*
2211	Broadwoven Cotton Weaving	211	281	314	323	69.8%	219	225
2221	Broadwoven Synthetic Weaving	268	321	449	422	21.1%	95	89
2241	Narrow Fabrics Weaving	292	224	335	258	13.3%	45	35
2281	Yarn Spinning	273	211	456	396	17.9%	82	71
2282	Winding and Throwing	172	111	196	137	5.3%	10	7
2284	Thread Mills	59	50	70	65	61.1%	42	39
Total		***1,275***	***1,198***	***1,820***	***1,601***	-	***493***	***466***

* Extrapolated from the 1977 percentages and 1992 number of establishments.

Sources: For 1977, Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Prepared for OSHA, Vol. II, Appendices, p. C-10 and A-6 (Exhibit A-2), January 1983; for 1992, 1992 Census of Manufactures, Industry Series, Department of Commerce, Bureau of Census.

Table 5
Firms and Establishments in Textile Mill Products (SIC 22) and Major Cotton-Using Textile SICs According to Number of Employees
1990-1996

SIC	1990				1991				1992				1993				1994				1995				1996			
	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+	1-19	20-99	100-499	500+
22																												
Firm	2,842	1,428	628	330	3,003	1,343	599	313	2,736	1,369	602	299	2,920	1,301	583	305	3,028	1,297	567	318	3,108	1,312	573	310	3,166	1,283	525	298
Estab.	2,843	1,475	851	1,472	3,007	1,385	822	1,475	2,738	1,425	831	1,446	2,923	1,351	809	1,451	3,033	1,345	786	1,488	3,114	1,354	783	1,511	3,169	1,336	747	1,464
2211																												
Firm	149	48	22	40	180	43	19	40	235	47	14	35	212	33	7	36	224	37	12	38	230	44	13	38	291	43	13	36
Estab.	149	48	24	90	180	43	19	89	236	47	14	77	212	34	7	72	224	37	12	80	230	44	13	80	291	43	13	85
2221																												
Firm	135	61	46	64	164	61	42	62	180	58	33	63	160	44	37	65	169	52	45	67	161	54	43	70	204	48	47	65
Estab.	135	62	50	176	164	62	45	171	180	59	36	165	160	45	41	164	169	54	49	173	161	56	46	182	204	49	52	170
2241																												
Firm	102	71	37	25	103	72	37	22	113	68	36	22	108	57	27	22	117	64	31	22	129	61	33	22	135	66	30	21
Estab.	102	72	46	46	103	74	49	39	113	70	49	39	108	59	34	46	117	66	40	43	129	63	40	46	135	68	41	42
2281																												
Firm	62	43	49	73	74	51	45	69	81	48	42	67	65	41	44	62	73	37	40	62	69	42	35	63	89	33	39	55
Estab.	62	43	61	250	74	53	57	250	81	49	56	246	65	42	58	236	73	38	51	233	69	43	46	241	89	34	55	224
2282																												
Firm	37	35	23	23	36	29	21	22	40	28	21	20	43	31	20	21	43	33	15	22	38	32	17	23	31	30	16	22
Estab.	37	38	25	38	36	31	23	37	40	31	23	38	43	32	26	46	43	36	18	45	38	33	22	47	31	31	20	45
2284																												
Firm	18	10	7	10	17	10	8	9	25	11	6	7	33	15	6	6	30	17	5	7	34	14	6	6	32	13	6	6
Estab.	18	11	9	21	17	10	10	20	25	11	8	17	33	15	7	20	30	18	5	22	34	14	7	22	32	13	7	21
Total *(2211 to 2284)*																												
Firm	503	268	184	235	574	266	172	224	674	260	152	214	621	221	141	212	656	240	148	218	661	247	147	222	782	233	151	205
Estab.	503	274	215	621	574	273	203	606	675	267	186	582	621	227	173	584	656	249	175	596	661	253	174	618	782	238	188	587

Source: Small Business Administration, Office of Advocacy (Firm Size Data Provided to SBA by Bureau of Census), "1990-1996 Four-Digit SIC Data, <http://www.sba.gov/advo/atats/int_data.html>, downloaded August 6, 1999.

Table 6

Value of Shipments for Textile Mill Products in Major Cotton-Using Textile SICs 1982, 1987, and 1992

SIC	Industry	Value of Shipments (in million $)					
		1982	1987	1992	Percent Change 1982 to 1987	Percent Change 1987 to 1992	Percent Change 1982 to 1992
22	Textile Mill Products	47,515.4	62,786.5	70,753.0	32.1%	12.7%	48.9%
2211	Broadwoven Cotton Weaving	3,972.0	5,508.3	5,814.0	38.7%	5.5%	46.4%
2221	Broadwoven Synthetic Weaving	8,191.2	8,048.9	8,793.5	-1.7%	9.3%	7.4%
2241	Narrow Fabrics Weaving	851.8	1,135.7	1313.9	33.3%	15.7%	54.2%
2281	Yarn Spinning	4,512.9	7,517.5	7,668.6	66.6%	2.0%	69.9%
2282	Winding and Throwing	1,994.7	2,124.2	2,771.9	6.5%	30.5%	39.0%
2284	Thread Mills	578.8	635.6	837.0	9.8%	31.7%	44.6%
Total for SICs 2211, 2221, 2241, 2281, 2282, and 2284		***20,101.4***	***24,970.2***	***27,198.9***	***24.2%***	***8.9%***	***35.3%***

Sources: For Textile Industry SICs, 1992 Census of Manufacturers, U.S. Department of Commerce, Bureau of the Census, Industry Series, MC92-I-22A and MC92-I-22D, Table 5-b. For Textile Mill Products, 1992 Census of Manufacturers, U.S. Department of Commerce, Subject Series, General Summary, MC92-S-I, Table 1-1a.

Table 7

Sales in Firms Within Major Cotton-Using SICs in the Textile industry 1996 and 1998

SIC	Sales (in million $)													
	1-19 employees		20-99 employees		100-499 employees		1-499 employees*		500+ employees		Employee Number Not Available**		Total Sales	
	1996	1998	1996	1998	1996	1998	1996	1998	1996	1998	1996	1998	1996	1998
2211	3,612.45	4,884.21	3,219.41	5,189.63	8,310.73	7,010.26	15,142.59	17,084.11	1,618.31	716.40	376.28	36.23	17,137.18	17,836.73
2221	1,287.52	2,909.33	1,793.55	2,173.31	5,708.17	3,277.29	8,789.24	8,359.93	1,176.78	1,400.41	46.63	423.39	10,012.65	10,183.73
2241	450.15	371.12	485.23	588.42	598.45	827.51	1,533.83	1,787.05	440.30	194.15	15.65	10.51	1,989.78	1,991.71
2281	385.83	704.61	993.80	909.23	2,843.48	3,186.81	4,223.11	4,800.64	491.80	562.07	1.05	8.33	4,715.96	5,371.05
2282	346.63	329.52	1,721.75	1,828.03	110.32	155.29	2,178.70	2,312.84	62.30	0.00	2.33	1.15	2,243.33	2,313.99
2284	810.87	884.39	421.51	427.42	838.40	823.59	2,070.78	2,135.40	0.00	0.00	17.09	6.30	2,087.87	2,141.70
Total	***6,082.58***	***10,083.19***	***8,635.28***	***11,116.03***	***18,409.59***	***15,280.75***	***33,938.25***	***36,479.97***	***3,789.49***	***2,873.03***	***459.03***	***485.91***	***38,186.77***	***39,838.91***

* Total sales in the 1-19, 20-99, and 100-499 employer size categories.
** This category includes firms not classified according to number of employees.

Source: Dun & Bradstreet Data, 1996 and 1998, provided by OSHA, Office of Regulatory Analysis.

Table 8

Total Employment in Firms Within Textile Mill Products (SIC 22) and Major Cotton-Using Textile SICs According to Number of Employees 1990-1996

	SIC 22						SICs 2211, 2221, 2241, 2281, 2282, and 2284					
	1-19 Employees	20-99 Employees	100-499 Employees	1-499 Employees*	500+ Employees	Total Employment	1-19 Employees	20-99 Employees	100-499 Employees	1-499 Employees*	500+ Employees	Total Employment
1990	16,882	64,464	120,715	202,061	478,702	680,763	2,891	12,286	34,355	49,532	216,661	266,193
1991	16,998	59,925	115,645	192,568	456,485	649,053	2,926	10,694	28,109	41,729	201,038	242,767
1992	16,228	61,293	117,565	195,086	456,079	651,165	3,126	9,768	25,654	38,548	199,234	237,782
1993	16,610	59,847	113,839	190,296	451,777	642,073	2,892	8,206	23,694	34,792	188,706	223,498
1994	16,450	58,813	110,381	185,644	459,015	644,659	3,233	10,667	27,811	41,711	206,776	248,487
1995	16,900	59,618	111,037	187,555	462,283	649,838	3,379	10,843	25,707	39,929	207,337	247,266
1996	17,337	57,583	100,543	175,463	434,103	609,566	4,043	10,500	29,008	43,551	185,835	229,386

*Total number of employees in the 1-19, 20-99, and 100-499 employer size categories.

Source: Small Business Administration, Office of Advocacy (Firm Size Data Provided to SBA by Bureau of Census), "1990-1996 Four-Digit SIC Data, <http://www.sba.gov/advo/atats/int_data.html>, downloaded August 6, 1999.

Table 9

Reductions in Byssinosis Incidence Rates and Cases as a Result of the OSHA Cotton Dust Standard (1978)

Report	Pre-Promulgation (1978) Estimates for Byssinosis			Reductions Predicted by Reports After Standard Implementation (Based on Exposure Reduction Only)				Results from Imbus' Study[1] After Standard Mostly Implemented (Including Exposure Reduction, Medical Surveillance, and Employee Rotation)			
	Estimated Number of Workers Exposed	Estimated Byssinosis Rate	Estimated Number of Cases*	Estimated Bysssinosis Rate	Estimated Number of Cases*	Estimated Reduction in Rate	Estimated Reduction in Cases	Reported Byssinosis Rate	Reported Number of Cases	Reduction in Byssinosis Rate	Reduction in Number of cases
Centaur Associates [2]	104,800	11.5%	12,052	6%	6,288	48%	5,764	0.68%	712	94%	11,340
Report to Congress[3]	251,400**	7.1-25.8%***	51,290	3.5-12.1%***	26,045	-	25,245	0.68%	1,710	-	49,580

* The case estimates are prevalence levels at one point in time – not number of cases over an extended period of time. The number of cases which would occur, or be presented over, for example, 10 years, would be substantially greater because workers enter and leave the workforce.

**The Report to Congress figures include workers in knitting and the agricultural sectors not covered by the OSHA standard. OSHA has subtracted out these numbers in this table.

***The Report to Congress presented rate estimates on a sector by sector basis. OSHA has combined these numbers in the table for clarity.

[1] H. R. Imbus "Medical Surveillance Data in the Textile Industry," 1983, OSHA Docket H-052C, Exhibit 175-60, Appendix I, 48 FR 26965, June 10, 1983.

[2] Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Part I, Report Prepared for OSHA, January 1983, OSHA Docket H-052 E, Exhibit 185.

[3] U.S. Department of Labor, "Cotton Dust: Review of Alternative Technical Standards and Control Technologies," Report to the Congress, 1979, OSHA Docket H-052B, Exhibit 169.

Table 10

Number of 29 CFR 1910.1043 (Cotton Dust Standard) Inspections in Major Cotton-Using Firms by SIC and Number of Employees 1978-1998

SIC	SIC Description	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total
2211	Broadwoven Cotton Weaving	2	6	42	29	79
2221	Broadwoven Synthetic Weaving	0	0	1	2	3
2241	Narrow Fabric Weaving	1	3	1	0	5
2281	Yarn Spinning	1	23	48	11	83
2282	Winding and Throwing	2	0	2	0	4
2284	Thread Mills	0	0	1	1	2
	All Other SICs Inspected	12	33	20	4	69
	TOTAL	***18***	***65***	***115***	***47***	***245***

Source: OSHA, IMIS Enforcement Database.

Table 11

Total Number of Violations Cited in Establishments By Number of Employees Cotton Textile Industry 1978-1998

Number of Employees	Total Number of Inspections	% of Inspections By Size	Total Number of Violations	% of Violations By Size
1-19	18	7.3%	85	7.9%
20-99	65	26.5%	282	26.3%
100-500	115	46.9%	529	49.3%
>500	47	19.2%	178	16.6%
TOTAL	***245***	***99.9%***	***1074***	***100.1%***

Source: OSHA, IMIS Data.

Table 12

29 CFR 1910.1043 (Cotton Dust Standard) Citations for Over-Exposure in Major Cotton-Using Establishments 1980-1998*

Standard		1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
PELs	1910.1043(c)(01)	1	12	37	17	67
Action Level	1910.1043(c)(02)	1	0	0	1	2
TOTAL		***2***	***12***	***37***	***18***	***69***

* No data are available for 1978-1979.

Source: OSHA, IMIS Data.

Table 13

Number of Violations Cited for 29 CFR 1910.1043 (Cotton Dust Standard) In Major Cotton-Using SICs 1980-1998

SIC	SIC Description	Year																			Total # of Viol.
		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
2211	Broadwoven Cotton Weaving	0	12	12	7	24	17	23	9	21	5	28	25	25	19	17	22	18	31	14	329
2221	Broadwoven Synthetic Weaving	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	6
2241	Narrow Fabric Weaving	0	0	5	5	0	0	0	0	0	0	0	0	0	0	2	7	0	0	0	19
2281	Yarn Spinning	17	16	12	46	27	15	13	9	50	35	0	22	40	4	28	46	14	15	1	410
2282	Winding and Throwing	0	0	0	4	0	0	0	0	10	0	0	0	5	0	0	0	0	2	0	21
2284	Thread Mills	0	0	0	0	0	0	0	0	0	0	13	0	0	0	1	0	0	0	0	14
All Other SICs with 1910.1043 Violations		1	0	6	26	14	6	4	14	27	19	18	14	30	9	22	34	5	7	19	275
TOTAL		***18***	***28***	***35***	***90***	***65***	***38***	***40***	***32***	***108***	***59***	***59***	***61***	***102***	***32***	***70***	***109***	***37***	***55***	***36***	***1074***

* No data are available for 1978-1979.

Source: OSHA, IMIS Data.

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(i)(01)	Training program	13	36	43	2	94
1910.1043(h)(03)	Periodic examinations	1	10	52	17	80
1910.1043(c)(01)	Permissible Exposure Limits (PEL)	1	12	37	17	67
1910.1043(e)(01)	Engineering and work practice controls. The employer shall institute engineering and work practice controls to reduce and maintain employee exposure to cotton dust at or below the permissible exposure limit specified in paragraph (c) of this section, except to the extent that the employer can establish that such controls are not feasible.	1	12	36	14	63
1910.1043(d)(02)	Initial monitoring. Each employer who has a place of employment within the scope of paragraph (a)(1), (a)(4), or (a)(5) of this section shall conduct monitoring by obtaining measurements which are representative of the exposure of all employees to airborne concentrations of lint-free respirable cotton dust over an eight-hour period. The sampling program shall include at least one determination during each shift for each work area.	11	23	21	7	62
1910.1043(h)(01)	General	14	32	14	2	62

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(g)	Work practices. Each employer shall, regardless of the level of employee exposure, immediately establish and implement a written program of work practices which shall minimize cotton dust exposure.	10	25	24	0	59
1910.1043(i)(02)	Access to training materials	9	19	25	2	55
1910.1043(d)(03)	Periodic monitoring	0	9	28	12	49
1910.1043(e)(03)	Compliance program	1	7	27	14	49
1910.1043(h)(02)	Initial examinations. The employer shall provide medical surveillance to each employee who is or may be exposed to cotton dust. For new employees, this examination shall be provided prior to initial assignment.	5	17	21	6	49
1910.1043(f)(03)	Respirator selection	4	15	20	7	46
1910.1043(h)(05)	Physician's written opinion	0	5	29	12	46
1910.1043(f)(01)	***General.*** For employees who are required to use respirators by this section, the employer must provide respirators that comply with the requirements of this paragraph.	1	11	14	13	39
1910.1043(f)(04)*	Respirator usage.	2	6	23	5	36

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(j)	Signs. The employer shall post the following warning sign in each work area where the permissible exposure limit for cotton dust is exceeded: WARNING, COTTON DUST WORK AREA, MAY CAUSE ACUTE OR DELAYED, LUNG INJURY, (BYSSINOSIS), RESPIRATORS, REQUIRED IN THIS AREA.	2	7	16	9	34
1910.1043(g)(01)	Compressed air "blow down" cleaning shall be prohibited where alternative means are feasible. Where compressed air is used for cleaning, the employees performing the "blow down" or "blow off" shall wear suitable respirators. Employees whose presence is not required to perform "blow down" or "blow of" shall be required to leave the area affected by the "blow down" or "blow off" during this cleaning operation.	2	5	11	7	25
1910.1043(d)(04)	Employee notification	1	2	11	6	20
1910.1043(g)(02)	Cleaning of clothing or floors with compressed air shall be prohibited.	1	5	11	2	19
1910.1043(k)(01)	Exposure measurements	0	3	12	3	18

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(e)(04)	Mechanical ventilation. When mechanical ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system to control exposure, such as capture velocity, duct velocity, or static pressure shall be made at reasonable intervals.	0	3	10	4	17
1910.1043(k)(02)	Medical surveillance	0	8	7	2	17
1910.1043(e)(02)	Whenever feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the permissible exposure limit, the employer shall nonetheless institute these controls to reduce exposure to the lowest feasible level, and shall supplement these controls with the use of respirators which shall comply with the provisions of paragraph (f) of this section.	1	1	9	1	12
1910.1043(f)(02)	Respirator program	3	2	5	2	12
1910.1043(g)(03)	Floor sweeping shall be performed with a vacuum or with methods designed to minimize dispersal of dust.	0	2	6	2	10
1910.1043(h)(04)	Information provided to the physician.	0	1	6	2	9
1910.1043(m)(02)	Startup dates	0	0	5	1	6

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(l)(01)	The employer shall provide affected employees or their designated representatives an opportunity to observe any measuring or monitoring of employee exposure to cotton dust conducted pursuant to paragraph (d) of this section.	0	1	1	3	5
1910.1043(g)(04)	In areas where employees are exposed to concentrations of cotton dust greater than the permissible exposure limit, cotton and cotton waste shall be stacked, sorted, baled, dumped, removed or otherwise handled by mechanical means, except where the employer can show that it is infeasible to do so. Where infeasible, the method used for handling cotton and cotton waste shall be the method which reduces exposure to the lowest level feasible.	0	1	1	1	3
1910.1043(c)(02)	Action levels	1	0	0	1	2
1910.1043(d)(01)	General	0	0	2	0	2
1910.1043(g)(05)*	The employer shall inspect, clean, maintain, and repair, all engineering control equipment and ventilation systems including power sources, ducts, and filtration units of equipment	0	0	2	0	2

Table 14

Most Frequently Cited Violations by Size of Establishment
Cotton Textile Industry
1980-1998

Standard	Name of Violation	1-19 Employees	20-99 Employees	100-500 Employees	>500 Employees	Total Number of Violations
1910.1043(c)(03)*	The employer shall assure that no employee who is exposed to cotton dust (except for exposures in yarn manufacturing and slashing and weaving covered by paragraphs (c)(1) and (c)(2)) is exposed to air borne concentrations of lint-free respirable cotton dust greater than 500 micrograms/cubic meter men concentration, averaged over an eight-hour period, as meaasured by a vertical elutriator or a method of equivalent accuracy and precision.	0	1	0	0	1
1910.1043(e)	Methods of compliance	0	0	0	1	1
1910.1043(e)(05)	^	1	0	0	0	1
1910.1043(k)(03)	Availability	0	0	0	1	1
1910.1043(l)(05)	^	0	1	0	0	1
TOTAL		***85***	***282***	***529***	***178***	***1074***
% of TOTAL		***8%***	***26%***	***49%***	***17%***	***100%***

* This paragraph from the 1978 Cotton Dust Standard had been cited in the data after 1985, even though the revised 1985 Standard does not contain this paragraph.

^ This paragraph could not be identified in either the 1978 or the 1985 version of the Cotton Dust Standard.

Source: OSHA, IMIS Data.

Table 15

SICs with the Most Violations Cited for 29 CFR 1910.1043 (Cotton Dust Standard) According to Number of Employees Per Firm 1980-1998

SIC	SIC Description	1-19 Employees	20-99 Employees	100-500 Employees	1-500 Employees*	>500 Employees	Total Number of Violations
2211	Broadwoven Cotton Weaving	14	34	188	236	93	329
2221	Broadwoven Synthetic Weaving	0	0	3	3	3	6
2241	Narrow Fabric Weaving	11	3	5	19	0	19
2281	Yarn Spinning	5	141	216	362	48	410
2282	Winding and Throwing	9	0	12	21	0	21
2284	Thread Mills	0	0	1	1	13	14
2299	Textile Goods, NEC	19	21	40	80	0	80
2392	House Furnishing, Except Curtains And Draperies	0	0	16	16	9	25
7349	Building Cleaning And Maintenance Services, NEC	5	28	0	33	0	33
	Violations in Other SICs	22	55	48	125	12	137
TOTAL		***85***	***282***	***529***	***896***	***178***	***1074***

* Total for violations in the 1-19, 20-99, and 100-500 employer size categories

Source: OSHA, IMIS Data.

Table 16

Percentage of Small and Large Businesses in Major Cotton-Using Textile Establishments 1977 and 1992

SIC	Description	% Small Business*		% Large Business	
		1977	1992	1977	1992
2211	Broadwoven Cotton Weaving	90.8%	95.5%	9.3%	4.5%
2221	Broadwoven Synthetic Weaving	76.6%	88.0%	23.4%	12.1%
2241	Narrow Fabrics Weaving	99.0%	98.4%	0.9%	1.6%
2281	Yarn Spinning	91.4%	95.6%	8.5%	4.3%
2282	Winding and Throwing	92.3%	94.8%	7.6%	5.1%
2284	Thread Mills	91.4%	90.6%	8.6%	3.1%

*By SBA definition for SIC 2211 small is defined as less than or equal to 1000 employees. For SICs 2221, 2241, 2281, 2282, and 2284, small is defined as less than or equal to 500 employees.

Sources: For 1977, Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Prepared for OSHA, Vol. II, Appendices, p. C-10, January 1983; for 1992, 1992 Census of Manufactures, Industry Series, Department of Commerce, Bureau of Census.

Table 17

Percentage of Small Businesses in Major Cotton-Using Textile Firms 1990 and 1996

SIC	Description	% Small Business [1]		% Large Business	
		1990	1996	1990	1996
2211	Broadwoven Cotton Weaving	100%[2]	100%	0	0
2221	Broadwoven Synthetic Weaving	79.4%	82.1%	20.6%	17.9%
2241	Narrow Fabrics Weaving	89.3%	91.6%	10.7%	8.4%
2281	Yarn Spinning	67.8%	74.5%	32.2%	25.5%
2282	Winding and Throwing	80.5%	77.7%	19.5%	22.3%
2284	Thread Mills	77.7%	89.4%	22.3%	10.6%

[1] The Small Business Administration (SBA) defines small business for SIC 2211, as firms with less than or equal to 1,000 employees. For SICs 2221, 2241, 2281, 2282, and 2284, firms with 500 or less employees are considered small businesses by the SBA.

[2] Data provided by the Small Business Administration for 1990 and 1996 do not indicate employee size category of more than 1000 employees.

NOTE: Table 17 provides percentage of textile firms, as compared to Table 16, which provides percentage of textile establishments. Also, Table 17 uses different years and data sources than Table 16. This explains the slight difference in percentages.

Source: Small Business Administration, Office of Advocacy (Firm Size Data Provided to SBA by Bureau of Census), "1990-1996 Four-Digit SIC Data," <http://www.sba.gov/advo/atats/int_data.html>, downloaded August 6, 1999.

Table 18

Number of Establishments by Number of Employees for Yarn Preparation and Weaving Sectors Using Some Cotton 1977 and 1992

SIC	SIC Description	1-19 Employees		20-99 Employees		100-500 Employees		>500 Employees		Total	
		1977	1992	1977	1992	1977	1992	1977	1992	1977	1992
2211	Broadwoven Cotton Weaving	122	206	28	26	80	40	84	41	314	313
2221	Broadwoven Synthetic Weaving	98	167	87	59	159	145	105	51	449	422
2241	Narrow Fabric Weaving	153	127	115	73	64	54	3	4	335	258
2281	Yarn Spinning	86	72	73	82	257	225	39	17	455	396
2282	Winding and Throwing	48	47	72	40	61	43	15	7	196	137
2284	Thread Mills	23	24	14	19	27	20	6	2	70	65
TOTAL		***530***	***643***	***389***	***299***	***648***	***527***	***252***	***122***	***1819***	***1591***
% of TOTAL		***29%***	***40%***	***21%***	***19%***	***36%***	***33%***	***14%***	***8%***	***100%***	***100%***

Sources: For 1977, Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Prepared for OSHA, Vol. II, Appendices, p. C-10, January 1983; for 1992, 1992 Census of Manufactures, Industry Series, Department of Commerce, Bureau of Census.

Table 19

Industry Norm Figures for Net Sales in Textile Mill Products (SIC 22) and Major Cotton-Using Textile SICs 1995 and 1998

SIC	Description	Sales and Profit					
		1995			1998		
		Number of Sample Establishments	$	Profit as % of Sales	Number of Sample Establishments	$	Profit as % of Sales
22	**Textile Mill Products**	1108			767		
	Net Sales		3,932,388			4,092,066	
	Net Profit (after tax)		137,634	3.5%		139,130	3.4%
2211	**Broadwoven Cotton Weaving**	109			81		
	Net Sales		8,214,709			4,062,877	
	Net Profit (after tax)		271,085	3.3%		125,949	3.1%
2221	**Broadwoven Synthetic Weaving**	82			60		
	Net Sales		6,665,006			14,380,920	
	Net Profit (after tax)		199,950	3.0%		316,380	2.2%
2241	**Narrow Fabrics Weaving**	73			47		
	Net Sales		2,637,926			5,457,580	
	Net Profit (after tax)		158,276	6.0%		185,558	3.4%
2281	**Yarn Spinning**	30			35		
	Net Sales		22,495,042			13,243,656	
	Net Profit (after tax)		539,881	2.4%		251,629	1.9%
2282*	**Winding and Throwing**	15			-		
	Net Sales		4,227,358		-	-	-
	Net Profit (after tax)		262,096	6.2%	-	-	-

* SIC 2282 data for 1998 and SIC 2284 data for 1995 and 1998 are not available.

Source: For 1995, Dun & Bradstreet, Industry and Financial Consulting Services, "Industry Norms and Key Business Ratios: Desk-Top Edition 1995-1996," Statistics in Over 800 Lines of Business, SIC #0100-8999, 1996. For 1998, Dun & Bradstreet, Industry and Financial Consulting Services, "Industry Norms and Key Business Ratios: One Year, Manufacturing SIC #2000-3999," 1999.

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APPENDICES

There are ten appendices to enhance this report and provide additional details:

- The first appendix provides the text for Section 610 of the Regulatory Flexibility Act, one of the two documents which mandate this review of the OSHA Cotton Dust Standard.

- Appendix II provides the text of the Introduction and Section 5 of Executive Order #12866, mandating regulatory planning and this review of the OSHA Cotton Dust Standard.

- Appendix III provides information for those not familiar with cotton textile manufacturing and/or where and how cotton dust is generated in the manufacturing process.

- Appendix IV provides details of recent research on exposure-response for byssinosis, including relationships between smoking and cotton dust exposures and between acute and chronic exposure hazards. It also details research on gram-negative bacterial endotoxin, one of the agents responsible for cotton dust disease.

- Appendix V provides an update on the Cotton Waste Processing and Cottonseed Processing industries.

- Appendix VI summarizes litigation, four cases in the U.S. Court of Appeals and two in the Supreme Court of the United States.

- Appendix VII tells details of the Cotton Dust Standard – PELs, action levels, and exempt industries and industry sectors.

- Appendix VIII provides details on washed cotton, especially the batch-kier system, a process which reduces the risk of exposure to cotton dust among textile workers.

- Appendix IX reviews details of new textile machinery and air handling equipment that has been developed since promulgation of the Cotton Dust Standard, which adds to the efficiency of compliance, and sometimes production as well.

- Appendix X provides details of the comments made in 1998, either at public meetings or in written response to the Docket.

APPENDIX I

THE REGULATORY FLEXIBILITY ACT – SECTION 610

The following relevant extract of text from the Regulatory Flexibility Act is taken from Title 5 of the United States Code, sections 601–612. The Regulatory Flexibility Act was originally passed in 1980 (P.L. 96-354) and was amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (P.L. 104-121).

§ 601. Definitions

For purposes of this chapter—

(1) the term "agency" means an agency as defined in section 551(1) of this title;

(2) the term "rule" means any rule for which the agency publishes a general notice of proposed rulemaking pursuant to section 553(b) of this title, or any other law, including any rule of general applicability governing Federal grants to State and local governments for which the agency provides an opportunity for notice and public comment, except that the term "rule" does not include a rule of particular applicability relating to rates, wages, corporate or financial structures or reorganizations thereof, prices, facilities, appliances, services, or allowances therefor or to valuations, costs or accounting, or practices relating to such rates, wages, structures, prices, appliances, services, or allowances;

(3) the term "small business" has the same meaning as the term "small business concern" under section 3 of the Small Business Act, unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register;

(4) the term "small organization" means any not-for-profit enterprise which is independently owned and operated and is not dominant in its field, unless an agency establishes, after opportunity for public comment, one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register;

(5) the term "small governmental jurisdiction" means governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand, unless an agency establishes, after opportunity for public comment, one or more definitions of such term which are appropriate to the activities of the agency and which are based on such factors as location in rural or sparsely populated areas or limited revenues due to the population of such jurisdiction, and publishes such definition(s) in the Federal Register;

(6) the term "small entity" shall have the same meaning as the terms "small business", "small organization" and "small governmental jurisdiction" defined in paragraphs (3), (4), and (5) of this section; and

(7) the term "collection of information"—

(A) means the obtaining, causing to be obtained, soliciting, or requiring the disclosure to third parties or the public, of facts or opinions by or for an agency, regardless of form or format, calling for either—

(i) answers to identical questions posed to, or identical reporting or recordkeeping requirements imposed on, 10 or more persons, other than agencies, instrumentalities, or employees of the United States; or

(ii) answers to questions posed to agencies, instrumentalities, or employees of the United States which are to be used for general statistical purposes; and

(B) shall not include a collection of information described under section 3518(c)(1) of title 44, United States Code.

(8) Recordkeeping requirement.—The term "recordkeeping requirement" means arequirement imposed by an agency on persons to maintain specified records.

* * *

§ 610. Periodic review of rules

(a) Within one hundred and eighty days after the effective date of this chapter, each agency shall publish in the Federal Register a plan for the periodic review of the rules issued by the agency which have or will have a significant economic impact upon a substantial number of small entities. Such plan may be amended by the agency at any time by publishing the revision in the Federal Register. The purpose of the review shall be to determine whether such rules should be continued without change, or should be amended or rescinded, consistent with the stated objectives of applicable statutes, to minimize any significant economic impact of the rules upon a substantial number of such small entities. The plan shall provide for the review of all such agency rules existing on the effective date of this chapter within ten years of that date and for the review of such rules adopted after the effective date of this chapter within ten years of the publication of such rules as the final rule. If the head of the agency determines that completion of the review of existing rules is not feasible by the established date, he shall so certify in a statement published in the Federal Register and may extend the completion date by one year at a time for a total of not more than five years.

(b) In reviewing rules to minimize any significant economic impact of the rule on a substantial number of small entities in a manner consistent with the stated objectives of applicable statutes, the agency shall consider the following factors—

(1) the continued need for the rule;

(2) the nature of complaints or comments received concerning the rule from the public;

(3) the complexity of the rule;

(4) the extent to which the rule overlaps, duplicates or conflicts with other Federal rules, and, to the extent feasible, with State and local governmental rules; and

(5) the length of time since the rule has been evaluated or the degree to which technology, economic conditions, or other factors have changed in the area affected by the rule.

(c) Each year, each agency shall publish in the Federal Register a list of the rules which have a significant economic impact on a substantial number of small entities, which are to be reviewed pursuant to this section during the succeeding twelve months. The list shall include a brief description of each rule and the need for and legal basis of such rule and shall invite public comment upon the rule.

APPENDIX II

INTRODUCTION AND SECTION 5 OF EXECUTIVE ORDER #12866 REGULATORY PLANNING AND REVIEW

INTRODUCTION

The American people deserve a regulatory system that works for them, not against them: a regulatory system that protects and improves their health, safety, environment, and well-being and improves the performance of the economy without imposing unacceptable or unreasonable costs on society; regulatory policies that recognize that the private sector and private markets are the best engine for economic growth; regulatory approaches that respect the role of State, local, and tribal governments; and regulations that are effective, consistent, sensible, and understandable. We do not have such a regulatory system.

With this Executive order, the Federal Government begins a program to reform and make more efficient the regulatory process. The objectives of this Executive order are to enhance planning and coordination with respect to both new and existing regulations; to reaffirm the primacy of Federal agencies in the regulatory decision-making process; to restore the integrity and legitimacy of regulatory review and oversight; and to make the process more accessible and open to the public. In pursuing these objectives, the regulatory process shall be conducted so as to meet applicable statutory requirements and with due regard to the discretion that has been entrusted to the Federal agencies.

Accordingly, by the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

* * * * *

Sec. 5. Existing Regulations

In order to reduce the regulatory burden on the American people, their families, their communities, their State, local, and tribal governments, and their industries; to determine whether regulations promulgated by the executive branch of the Federal Government have become unjustified or unnecessary as a result of

changed circumstances; to confirm that regulations are both compatible with each other and not duplicative or inappropriately burdensome in the aggregate; to ensure that all regulations are consistent with the President's priorities and the principles set forth in this Executive order, within applicable law; and to otherwise improve the effectiveness of existing regulations: (a) Within 90 days of the date of this Executive order, each agency shall submit to OIRA a program, consistent with its resources and regulatory priorities, under which the agency will periodically review its existing significant regulations to determine whether any such regulations should be modified or eliminated so as to make the agency's regulatory program more effective in achieving the regulatory objectives, less burdensome, or in greater alignment with the President's priorities and the principles set forth in this Executive order. Any significant regulations selected for review shall be included in the agency's annual Plan. The agency shall also identify any legislative mandates that require the agency to promulgate or continue to impose regulations that the agency believes are unnecessary or outdated by reason of changed circumstances.

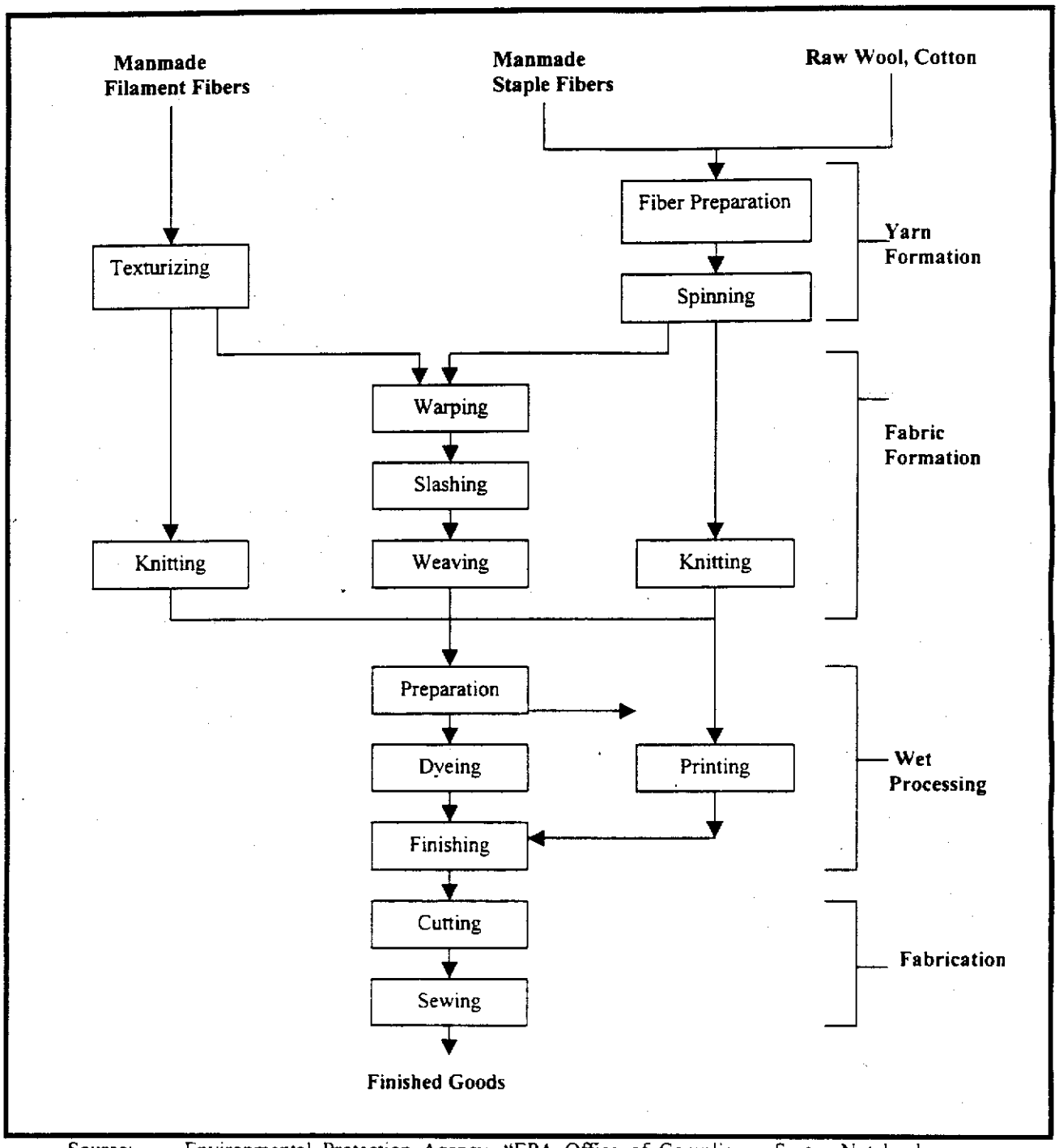
(b) The Administrator of OIRA shall work with the Regulatory Working Group and other interested entities to pursue the objectives of this section. State, local, and tribal governments are specifically encouraged to assist in the identification of regulations that impose significant or unique burdens on those governmental entities and that appear to have outlived their justification or be otherwise inconsistent with the public interest.

(c) The Vice President, in consultation with the Advisors, may identify for review by the appropriate agency or agencies other existing regulations of an agency or groups of regulations of more than one agency that affect a particular group, industry, or sector of the economy, or may identify legislative mandates that may be appropriate for reconsideration by the Congress.

APPENDIX III

THE TEXTILE MANUFACTURING PROCESS AND ASSOCIATED COTTON DUST HAZARDS

Typical Flowchart for Textile Manufacturing



Source: Environmental Protection Agency, "EPA Office of Compliance Sector Notebook Project: Profile of the Textile Industry," Office of Compliance, Office of Enforcement and Compliance Assurance, Washington DC, EPA/310-R-97-009, September 1997.

Areas and Levels of Exposure

The levels of cotton dust and the composition of dust fibers vary at each step in the processing of raw cotton to cloth. The steps involve opening the bales (which consist of raw cotton mixed with leaf trash and other foreign matter), cleaning out the trash, opening the cotton tufts into fibers, blending the fibers with other material such as synthetics, drawing out the fibers, spinning them into yarn, spooling the yarn, and finally, weaving the yarn into cloth. (For a typical textile processing flow-chart, see the first page of this Appendix).

The greatest cotton dust hazards come in the early preparation processes -- opening, cleaning, blending, picking, and also carding. Other sources of dust released in the opening/cleaning process, according to ATMI, are the removal and manual handling of waste from hoppers and cleaners and machine cleaning.[1]

Carding, the next stage in the processing, is the major point of dust generation in yarn manufacturing. Prior to the Cotton Dust Standard, 20 to 30 percent of cardroom workers developed acute byssinosis within a year or less of exposure.[2]

Drawing is the next stage, which involves blending the carded slivers to make them more uniform and parallel. Drawing frames are typically enclosed and use vacuum cleaning systems to remove short fibers. A 1974 NIOSH study[3] indicates that draw frames do not seriously contribute to the dust load in the room due to this reason. Reported dust operations in the drawing operation before the current standard ranged from 300 to 800 microgram/cubic meter. Use of local exhaust ventilation in the drawing area brought the drawing process into compliance with the levels

[1] Ruth Ruttenberg, "Compliance with the OSHA Cotton Dust Rule: The Role of Productivity Improving Technology," Final Report to the Office of Technology Assessment (OTA), U.S. Congress, March 1983, Contract No. 233-7050.0.

[2] Ibid., p. 11.

[3] National Institute for Occupational Safety and Health (NIOSH), "Occupational Exposure to Cotton Dust," 1974.

recommended by the cotton dust standard. A study conducted for NIOSH found that exhaust ventilation at drawing frames brought down dust levels to 98 μ/m^3.[4]

Roving, which gets the sliver from drawing ready for spinning, is not generally cited as a major source of dust.

Spinning reduces the roving to the desired yarn size and imparts the amount of twist required for yarn strength. During the traditional spinning method called "ring spinning," a large proportion of the fine trash remaining at the spinning operation is released. The most commonly used systems for catching the loose fibers are travelling blowers that go alongside the spinning frames, blowing accumulated fly and associated trash off them. Vacuum sweepers are usually installed to suck up the lint and the dust blown by the travelling frame cleaner. By the mid-1970s "open-ended" spinning emerged as a new technology with a production rate four to five times that of the ring spindle, labor and cost saving features, and the ability to greatly reduce the fly in the room because open-ended fibers are sucked into the rotor.

Spooling is the specialized form of winding that includes a mechanism to remove debris from the yarn. The resulting dust and lint is usually filtered, but some dust is allowed to pass back into the room.

Twisting combines more than two strands of yarn to form ply yarns. The NIOSH study found that by this point in the process, there is little active agent left to be released.

Warping is the process by which several hundred individual stands of yarn are formed into a parallel sheet and wound onto a warp beam for slashing or dyeing. A

[4] Enviro Control, Inc., "Control Technology Assessment of Raw Cotton Processing Operations," study conducted for NIOSH, NTIS, June 15, 1980.

study by the Research Triangle Institute (RTI) noted that little active toxic agent remains in the processed yarn at this point.[5]

Weaving is one of the major methods for fabric manufacture apart from knitting. Weaving, or interlacing yarns, is the most common process used to create fabrics. Weaving is done on looms where dust is released by the abrasive movements of the loom components, the harness and reeds, on the yarn. NIOSH studies indicate dust-related health effects among weavers prior to the Cotton Dust Standard. However, new shuttleless looms have substantially reduced dust and increased productivity while also alleviating noise, temperature, and humidity problems.

[5] Research Triangle Institute (RTI), "Cotton Dust: Technological Feasibility Assessment and Final Inflationary Impact Statement," Part I, report prepared for OSHA, 1976.

APPENDIX IV

RECENT EXPOSURE-RESPONSE RESEARCH EFFORTS ON BYSSINOSIS

The earlier research on the relationship between cotton dust and byssinosis is discussed in the preamble of the 1978 OSHA Cotton Dust Standard[1] and the 1985 rule,[2] as well as in Chapter I of this report. The most recent studies on cotton dust exposure have concentrated on three major issues: synergistic effects of smoking and exposure to cotton dust leading to chronic bronchitis, the relationship between acute and chronic hazard from exposure to cotton dust, and identification of specific agents in cotton dust involved in production of the short-term and long-term exposure symptoms.

Synergism Between Smoking and Cotton Dust Exposures

Chronic bronchitis is more prevalent in cotton workers than in those working with man-made fiber and exposure is additive to the effect of smoking.[3] Studies on exposure to cotton dust among smokers indicate synergism between smoking and cotton dust exposures. In fact, evidence from a study by Glindmeyer et al. suggests that smokers may be at risk for chronic health effects from cotton dust exposure even at current levels.[4] Results of this study show dust-related accelerated decline

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[1] U.S. Department of Labor, "Occupational Exposure to Cotton Dust: Final Mandatory Occupational Safety and Health Standards," Federal Register, Vol. 43, No. 122, June 23, 1978, pp. 27350-27434.

[2] U.S. Department of Labor, "Occupational Exposure to Cotton Dust: Final Rule," 29 CFR Part 1910, Federal Register, Vol. 50, No. 240, December 13, 1985, pp. 51120-51179.

[3] R. M. Niven, A. M. Fletcher, C. A. Pickering, D. Fishwick, C. J. Warburton, J. C. Simpson, H. Francis, L. A. Oldham, "Chronic Bronchitis in Textile Workers," Thorax, January 1997, Vol. 52, No. 2, pp. 22-27.

[4] H. W. Glindmeyer, J. J. Lefant, R. N. Jones, R. J. Rando, H. M. Abdel, and Weill H., "Exposure-Related Declines in Lung Function of Cotton Textile Workers: Relationship to Current Workplace Standards," American Review of Respiratory Disease, 1991, Vol. 144, pp. 675-683.

in cotton textile workers' lung function even at the 200 microgram/cubic meter PEL among those who smoke. This 5-year longitudinal study examined exposure and annual change in FEV_1/lung function among 1,817 slashing and weaving and yarn manufacturing workers to evaluate the effectiveness of workplace standards in preventing chronic health effects from cotton dust exposure. In each smoking category, cotton yarn workers had a steeper annual decline in lung function than the workers in slashing and weaving, thus exhibiting a dust potency effect. The largest declines were observed in cotton yarn workers that smoke. The largest declines were also found in mills using the highest percentage and lowest grade of cotton.

Relationship Between Acute and Chronic Hazards From Exposure to Cotton Dust

In 1994, a five-year longitudinal study of 1,644 workers employed in cotton yarn manufacturing at six cotton textile mills, evaluated exposure and across-shift FEV_1 as possible predictors of annual change in FEV_1 for yarn manufacturing workers.[5] A total of 611 workers had three repeatable spirometric tests over at least 3 years and at least one (average of three) across-shift test, while always working the same shift. Average exposure was determined by measures of lint-free elutriated cotton dust in combination with job histories. Results indicated a significant association between the acute and chronic effects of exposure to cotton dust. Both exposure and across shift change proved to be significant predictors of annual change. Excess annual declines in FEV_1 were predicted even for exposures of 200 micrograms/cubic meter and across-shift drops in FEV_1 of 200 ml.

[5] H. W. Glindmeyer, J. J. Lefant, R. N. Jones, R. J. Rando, and H. Weill, "Cotton Dust and Across-Shift Change in FEV_1 as Predictors of Annual Change in FEV_1," American Journal of Respiratory and Critical Care Medicine, 1994, Vol. 149, pp. 584-590.

Gram-Negative Bacterial Endotoxin[6]

Cotton dust is a heterogeneous mixture of plant parts and contaminants from soil, weeds, and microorganisms. Research to control byssinosis has focused on methods to reduce the trash associated with harvested fiber and control the dust in the textile mill environment. Identification of causative agents is difficult and variables that influence the levels of contaminants in dust have to be taken into account as well. Byssinosis has been related to endotoxin exposure in cotton mills, but studies indicate that similar symptoms may be found in other work places.[7]

Recent studies have implicated gram-negative bacterial endotoxin as one of the agents responsible for acute, and possibly chronic, respiratory illness. While previous studies failed to identify the specific agent in cotton dust which is responsible for the symptoms associated with byssinosis, cotton dust health effect studies over the past decade revealed a better exposure-response relationship for gram negative bacterial endotoxin than for dust when examining acute responses such as changes in Forced Expiratory Volume (FEV_1).[8]

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[6] Gram-negative bacteria possess lipopolysaccharide-protein complexes termed endotoxins as an integral portion of their cell walls. Airborne exposures in humans to gram-negative bacteria and their endotoxins have resulted in constriction of the airways and symptoms of chest tightness and shortness of breath. Cotton dust is often heavily contaminated and endotoxin has been postulated to be the agent in cotton dust which is responsible for the byssinosis syndrome.

[7] J. Merchant, J. C. Lumsden, and K. H. Kilburn, "Dose-Response Studies in Cotton Textile Workers," Journal of Occupational Medicine, 1973, Vol. 15, pp. 222-230.

[8] D. C. Christiani, D. H. Wegman, E. A. Eisen, T. T. Ye, P. L. Lu, S.A. Olenchock, "Cotton Dust and Gram-Negative Bacterial Endotoxin Correlations in Two Cotton Textile Mills," American Journal of Industrial Medicine, February 1993, Vol. 23, No. 2, pp. 333-342.

Endotoxin and Acute Respiratory Effects[9]

A recent study from England found that increasing current personal exposure to dust or endotoxin was found to be predictive of upper and lower respiratory tract symptoms, chronic bronchitis, and byssinosis.[10] Several other studies[11,12,13,14] have also documented an association between endotoxin concentration and respiratory symptoms of exposed individuals; even more clearly, they have demonstrated a relationship between endotoxin and across-shift FEV_1 decrement among humans exposed to cotton dust. The most definitive findings were reported by NIOSH investigators, who observed a clear exposure-response relationship between mean FEV_1 response and endotoxin concentration, although dust concentrations from the same set of exposures were not correlated with FEV_1 change.[15] All 51 exposures

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[9] National Institute for Occupational Safety and Health, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," the Task Force for Byssinosis Prevention (formerly the Industry/Government/Union Task Force for Washed Cotton Evaluation), U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention National Institute for Occupational Safety and Health Division of Respiratory Disease Studies, August 1995, DHHS (NIOSH) Publication No. 95-113.

[10] J. C. Simpson, R. M. Niven, C. A. Pickering, A. M. Fletcher, L. A. Oldham, and H. M. Francis, "Prevalence and Predictors of Work Related Respiratory Symptoms in Workers Exposed to Organic Dust," Occupational and Environmental Medicine, Vol. 555, No. 10, October 1998, pp. 668-672.

[11] R. Rylander and P. Haglind, "Relation Between FEV_1 Changes Over Workshift And Dust/Endotoxin Levels, in P. J. Wakelyn, R. R. Jacobs, eds. Proceedings, Seventh Cotton Dust Research Conference, Memphis, TN: National Cotton Council, 1983, pp. 17-18.

[12] R. M. Castellan, S. A. Olenchock, J. L. Hankinson, P. D. Millner, J. B. Cocke, and C. K. Bragg et al., "Acute Bronchoconstriction Induced By Cotton Dust: Dose-Related Responses To Endotoxin And Other Dust Factors," Annals of Internal Medicine, 1984, Vol. 101, pp. 157-163.

[13] R. Rylander, P. Haglind, and M. Lundholm, "Endotoxin In Cotton Dust And Respiratory Function Decrement Among Cotton Workers In An Experimental Cardroom," American Review of Respiratory Diseases, 1985, Vol. 131, pp. 209-213.

[14] R. M. Castellan, S. A. Olenchock, K. B. Kinsley, J. L. Hankinson, "Inhaled Endotoxin And Decreased Spirometric Values: An Exposure-Response Relation For Cotton Dust," New England Journal of Medicine, 1987, Vol. 317, pp. 605-610.

[15] Castellan et al., 1987.

above 50 $\mu g/m^3$ endotoxin resulted in statistically significant mean FEV_1 responses, whereas none of the eight exposures below 10 $\mu g/m3$ endotoxin did so, and a linear regression model based on the observed data predicted a "threshold" at approximately 9 $\mu g/m^3$ for the FEV_1 response.[16]

Although these experimental results do not by themselves prove that endotoxin is causal, the very clear exposure-response relationship between airborne endotoxin concentration and acute decline in FEV_1 is unlikely to have been observed unless a substantial causal role is played by endotoxin or some other cotton dust component (or components) in a concentration that closely parallels that of endotoxin. On the basis of this exposure-response relationship, NIOSH concluded in a letter to OSHA that although "it is not now possible to offer a definitive opinion regarding chronic health effects, ... airborne endotoxin is a valid surrogate for the level of acute respiratory hazards of cotton dust."[17]

Additional field studies need to be performed which consider the various determinants of dust and endotoxin levels. The relationship among exposure to organic dust, microorganisms, endotoxins and other chemicals in the work place and disease needs further research in order to identify the agents that cause byssinosis and development of methods to eliminate those agents from cotton is needed to prevent new cases of byssinosis.

Endotoxin and Chronic Respiratory Effects[18]

The demonstrated relationship between acute and chronic respiratory responses to cotton dust[19] and the demonstrated relationship of acute respiratory response and

[16] Ibid.

[17] R. W. Niemeier. Letter of September 12, 1990 from R. W. Niemeier, Director, Division of Standards Development and Technology Transfer, National Institute for Occupational Safety and Health, to C. E. Adkins, Director, Health Standards Programs, Occupational Safety and Health Administration, 1990.

[18] National Institute for Occupational Safety and Health, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton." August 1995.

endotoxin,[20] together offer a basis for accepting the endotoxin measurements made during the washing studies as a surrogate for the chronic respiratory hazard of cotton dust, as well as for the acute respiratory hazard. Additional evidence for considering endotoxin inhalation a risk factor for chronic lung effects is provided by other studies that have demonstrated quantitative relationships between chronic respiratory effects and exposure to airborne, endotoxin-contaminated organic dust. These studies have involved textile mill workers,[21] Dutch animal feed mill workers,[22] and workers in the swine confinement industry,[23] an occupational setting in which an exposure-effect relationship of airborne endotoxin exposure with across-shift FEV_1 decrement has been reported.[24]Dutch animal feed mill workers,[25] and workers in the swine confinement industry,[26] an

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[19] H. W. Glindmeyer et al., 1994.

[20] Rylander and Haglind 1983, 1986; Castellan et al. 1984, 1987; and Rylander et al., 1985.

[21] S. M. Kennedy, D. C. Christiani, E. A. Eisen, D. H. Wegman, I. A. Greaves, S. A. Olenchock, et al., "Cotton Dust And Endotoxin Exposure-Response Relationships In Cotton Textile Workers," American Review of Respiratory Diseases, 1987, Vol. 135, pp. 194-200, and T. Sigsgaard, O. F. Pedersen, S. Juul, S. Gravesen, " Respiratory Disorders and Atopy in Cotton, Wool, and Other Textile Mill Workers in Denmark," American Journal of Industrial Medicine, 1992, Vol. 22, pp. 163-184.

[22] T. Smid, D. Heederick, R. Houba, and P. H. Quanjer, "Dust - and Endotoxin-Related Respiratory Effects In The Animal Feed Industry," American Review of Respiratory Diseases, 1992, Vol. 146, pp. 1474-1479.

[23] J. E. Zejda, E. Barber, J. A. Dosman, S. A. Olenchock, H. H. McDuffie, C. Rhodes, and R. Hurst, "Respiratory Health Status In Swine Producers Relates To Endotoxin Exposure In The Presence Of Low Dust Levels," Journal of Occupational Medicine, 1994, Vol. 36, pp. 49-56.

[24] K. Donham, P. Haglind, Y. Peterson, R. Rylander, and L. Belin, "Environmental and Health Studies of Farm Workers In Swedish Swine Confinement Buildings," British Journal of Industrial Medicine, 1988, Vol. 46, pp. 31-37, and D. Heederick, K. Brouwer, K. Biersteker, J. S. M. Boleij, "Relationship of Airborne Endotoxin and Bacteria Levels in Pig Farms with the Lung Function and Respiratory Symptoms in Farmers," International Archives of Occupational Environmental Health, 1991, Vol. 62, pp. 595-601.

[25] T. Smid, D. Heederick, R. Houba, and P. H. Quanjer, "Dust - and Endotoxin-Related Respiratory Effects In The Animal Feed Industry," American Review of Respiratory Diseases, 1992, Vol. 146, pp. 1474-1479.

[26] J. E. Zejda, E. Barber, J. A. Dosman, S. A. Olenchock, H. H. McDuffie, C. Rhodes, and R. Hurst, "Respiratory Health Status In Swine Producers Relates To Endotoxin Exposure In The Presence Of Low Dust Levels," Journal of Occupational Medicine, 1994, Vol. 36, pp. 49-56.

occupational setting in which an exposure-effect relationship of airborne endotoxin exposure with across-shift FEV_1 decrement has been reported.[27]

[27] K. Donham, P. Haglind, Y. Peterson, R. Rylander, and L. Belin, "Environmental and Health Studies of Farm Workers In Swedish Swine Confinement Buildings," British Journal of Industrial Medicine, 1988, Vol. 46, pp. 31-37, and D. Heederick, K. Brouwer, K. Biersteker, J. S. M. Boleij, "Relationship of Airborne Endotoxin and Bacteria Levels in Pig Farms with the Lung Function and Respiratory Symptoms in Farmers," International Archives of Occupational Environmental Health, 1991, Vol. 62, pp. 595-601.

APPENDIX V

COTTONSEED AND WASTE PROCESSING INDUSTRIES

The cottonseed and waste processing industries have continued to grow and diversify since the promulgation of the Cotton Dust Standard by OSHA.

Application of the Cotton Dust Standard to the Cottonseed and Waste Processing Industries

The Cotton Dust Standard has limited application in cottonseed processing and cotton waste processing operations. Cottonseed processing operations are not subject to an OSHA 8-hour time-weighted average PEL. However, cottonseed-processing operations are covered by certain medical surveillance provisions and medical record keeping provisions of the Cotton Dust Standard (29 CFR 1910.1043) as specified in Sec. 1910.1043 (a) (3). The cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garnetting must comply with a PEL of 1 mg/m as an 8-hour time weighted average. This PEL is contained in the Air Contaminants Standard (1910.1000) rather than in 1910.1043. However, cotton waste processing operations are covered by certain medical surveillance and medical record keeping requirements of the Cotton Dust Standard as specified in Sec. 1910.1043 (a) (3). These industries are included in this regulatory review.[1]

Cottonseed Industries

The process of ginning, involving the separation of lint cotton from the cottonseed and trash (leaf and bark) generates the byproduct of cottonseed. The cottonseed processing industry turns the seed into oil and other products. About half the cottonseed in the U.S.

[1] "Notice of Public Meeting on Review of the Cotton Dust Standard," 63 FR 34140 (June 23, 1998).

is used to make cottonseed oil and half is used as animal feed. Cottonseed was the first major vegetable oil used in the United States.[2]

In addition to use of cottonseed oil for cooking, cottonseed meal is a high protein supplement for livestock and poultry; hulls are a roughage for cattle feed; and linters are a cellulose feed stock for many industrial and consumer products. The fact that cottonseed is conveniently handled and requires no processing makes it a very desirable feed. Selling cottonseed as animal feed is profitable, and these sales have grown considerably over the last decade. Some gins take cottonseed in exchange for the price of milling. Scientists from the Agricultural Research Service of the Department of Agriculture are testing a new biopesticide containing a mixture of cottonseed oil, sucrose, water and other ingredients that stimulate armyworm feeding as an alternative to chemical insecticides.[3]

In North Carolina, for example, the acreage of cotton grown has increased in recent years. This has simultaneously increased the supply of whole cottonseed available to cattlemen. Cottonseed is an economical buy for cattle farmers. In several years of the 1990s whole cottonseed has been available at less than $100/ton, well below the actual value of its nutrients of about $140/ton.[4] Cottonseeds, as a by-product of cotton, account for 10 to 15 percent of the value of a bale. It would not be economical to grow cotton for oil production if cotton were not being produced for its fiber content. The economic health of cottonseed oil mills is, therefore, dependent on the quantity of

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[2] U.S. Department of Agriculture, Agricultural Research Service, "Isohexane – New Solvent for Cottonseed Oil Processing," Agricultural Research, August 1996, Vol. 44, No. 8, http://www.ars.usda.gov/is/AR/archive/aug96/index.html, downloaded June 23, 2000.

[3] U.S. Department of Agriculture, Agricultural Research Service, IPM/Biological Control, http://www.ars.usda.gov/is/qtr/q398/ipm398.htm, downloaded June 23, 2000.

[4] M. H. Poore, "Cottonseed and Cotton Textile Mill Waste in Sorghum Silage-Based Diets for Developing Heifers," http://www.cals.ncsu.edu/an_sci/ann_rep94/mhpoo46.html, downloaded March 16, 2000.

cotton produced in textile mills,[5] and in the last decade, cotton has registered significant market share gains and is becoming a more important player in the market for non-wovens.[6]

Cottonseed Oil Mills. Cottonseed Oil Mills are establishments primarily engaged in manufacturing cottonseed oil, cake, meal, and linters, or in processing purchased cottonseed oil into edible cooking oils. In 1997 there were 35 cottonseed oil processing establishments in the United States.[7] With 1600 production workers, nationwide and over 2000 total employees, this industry sector had a value of shipments of $845 million. All establishments had fewer than 250 employees. Between the Census of Manufactures in 1992 and the next one in 1997, the value of shipments, in categories of cotton oilseed products with data available from both surveys, rose by 20 percent. (See table below.)

Value of Shipments
Cottonseed Oil Products
1992 and 1997

NAICS Product Code	Product	1992 Value of Shipments (Thousand $)	1997 Value of Shipments (Thousand $)	%Change
3112231	Cottonseed Oil, Crude	$102,101	$89,850	-(12.0%)
3112234	Cottonseed Oil Once-Refined (after alkali caustic wash but before deodorizing or use in end products)	183,889	176,448	-(4.1%)
3112237	Cotton Linters	54,749	82,913	51.9%
	Cottonseed Cake and Meal	216,096	317,064	46.7%
Total		$556,835	$666,275	19.7%

Source: U.S. Census Bureau, 1997 Economic Census, "Other Oilseed Processing, Manufacturing Industry Series," October 12, 1999.

[5] Arthur D. Little, Inc., " Feasibility, Cost and Economic Impact of Control Options for Reducing Formaldehyde Exposure to Apparel Workers and Residents of Conventional and Manufactured Homes," Report to the Formaldehyde Institute, Reference 52862, October 1984, OSHA Docket H225, Exhibit No. 50, p. II-21.

[6] Cotton Incorporated, "Cotton Incorporated: Company History," http://www.CottonInc.com/AboutCotton/homepage.cfm?PAGE=3&CFID=92356& CFTOKEN=51578804, downloaded August 5, 1999.

[7] U.S. Census Bureau, 1997 Economic Census, "Other Oilseed Processing, Manufacturing -- Industry Series," October 12, 1999. Cottonseed Oil Processing is NAICS 207410.

Edible Cottonseed Cooking or Salad Oil. The edible cottonseed cooking or salad oil industry, NAICS 311225151, increased production and value of shipments, from 1992 to 1997. Production increased by over 90 percent, from 106 million pounds to 204 million from 1992 to 1997.[8] Value of shipments more than doubled, from $35 million in 1992 to over $75 million in 1997.

Cotton Waste Processing Industries

Cotton waste is generated by spinning and weaving mills when making yarns and fabrics. Cotton wastes also include: card waste, motes, thread waste, selvage waste, catchcord, slasher waste, bagging, filament waste, raw gin motes, recleaned gin motes, and cotton linters.

Cotton waste processing companies are part, but only part, of SIC 2299, Textile Goods, N.E.C. (Not Elsewhere Classified). The leading states for employment of companies in 2299 are New York, North Carolina, and South Carolina. Those three states accounted for 38 percent of the industry by employment.[9]

The cotton waste processing industries turn waste into various products. They include the processors of soft cotton waste (fibrous waste cotton that has undergone the yarn manufacturing process) and hard cotton wastes (rags, threads, yarns) as well as other facilities, which also process non-cotton waste or have shoddying operations.[10] Some companies reprocess textile waste and fiber by-products. Some grade and export the waste materials for further use. Some companies recycle textile waste products. As discussed above, not all waste processing operations are covered by the standard.

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[8] U.S. Census Bureau, 1997 Economic Census, "Other Oilseed Processing, Manufacturing -- Industry Series," October 12, 1999. Edible Cottonseed Cook or Salad Oil is NAICS 3112251561.

[9] U.S. Bureau of the Census, 1992 Economic Census, "Miscellaneous Textile Goods," MC92-1-22 E, p. 5.

[10] Shoddying involves the recycling of manufactured fabric threads and yarns.

The textile and cotton waste processing industry has more than 1,000 businesses and organizations, employs tens of thousands of people,[11] and recycles hundreds of thousands of tons of waste.

Each year 750,000 tons of pre-consumer textile waste is recycled and of that, 75 percent is diverted from landfills and recycled. A council for Textile Recycling exists to increase the amount of textile waste that is recovered and also to develop new uses, products, and markets. The Council for Textile Recycling boasts of recent expansion and growth on its web page.[12] It cites the progress of the textile waste industry in marketing products that benefit the environment and points to still unused processing capacity.

Cotton waste can be used as a raw material for a wide variety of products, including spinning coarse yarns, open-end spinning, non-woven products, and paper making as well as medical products, filling for mattresses, and felts. Cotton textile mill waste is another alternative feed. Cottonseed and cotton textile mill waste are increasingly used in sorghum silage-based diets for developing heifers.[13]

The environmental movement in post-regulatory years has created new markets for cotton textile waste. One Oregon company, for example, develops printing and writing papers made from cotton waste. It provides high-quality papers that are environmentally responsible and economically sound.[14]

The cotton waste processing industry is finding new uses for reprocessed and recycled cotton textile waste, which adds to the grade and market value of cotton.[15] One company,

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[11] "Council for Textile Recycling," http://www.textilerecycle.org/ctrinfo.htm , downloaded June 15, 2000.

[12] Ibid.

[13] M. H. Poore, "Cottonseed and Cotton Textile Mill Waste in Sorghum Silage-Based Diets for Developing Heifers," http://www.carlr.rcsu/an_sciann_rep94/mhoo46.html, downloaded March 16, 2000.

[14] Living Tree Paper Company, http://www.livingtreepaper.com/, downloaded March 16, 2000.

[15] Gino J. Mangialardi and W. Stanley Anthony, "Ginning: Field Evaluation of Air and Saw Lint Cleaning Systems," Journal of Cotton Science, 2:53-61 (1998), pp. 53-61.

for example, talks of developing better products and becoming a major supplier of wiping materials to companies throughout the U.S. and the world.[16]

Listed below are some of the products made from reprocessed and recycled cotton fibers:

- Trunkliners, sound deadening pads, and headliners in the automotive industry, from machined denim cuttings.
- Cotton felts and insulator pads in the mattress industry from cleaned card waste and linters.
- Mop yarns and upholstery yarns in the yarn spinning industry, from opened thread waste and cleaned card waste.
- Pillows and comforters in the home furnishings industry from machined white thread waste.
- Bleached fiber for the medical industry from cleaned cotton card waste and machined cotton threads.

The textile sector, which includes cotton waste processing has increased its economic health. Its growth over the five years 1992 to 1996 (1996 is the last year for which full data are available), surpasses U.S. manufacturing generally. From 1992 through 1996, the value of shipments for the 4 digit SIC which includes cotton waste processing rose by 34%, in contrast to a 24% rise in overall manufacturing. (See table below.) In addition, SIC 2299 did better than manufacturing generally in percentage increases in number of production employees, 17% vs.15% and in percentage increases in number of production hours worked, 15% vs. 6%. Also 67% of establishments in this sector have fewer than 20 employees.

[16] Textile Buff & Wheel Company, Inc., http://www.textilebuff.com/main.htm, updated March 6, 1999, downloaded March 16, 2000.

Value of Shipments
Textile Goods, N.E.C.,
1992 and 1996*

SIC Code	Product	1992 Value of Shipments (Thousand$)	1996 Value of Shipments (Thousand$)	%Change	% Change U.S. Manuf.
2299	Textile Goods, N.E.C.	$1,796,000	$2,404,000	33.9%	23.7%

* Value of Shipments data for the entire category are not available.
Source: Census of Manufactures, Statistics for 1992 and 1996.

The industries of cottonseed processing and cotton waste processing include virtually all small businesses. Only part of the Cotton Dust Standard applies to them. The industries are growing, the value of their shipments are increasing, and they are developing new products. OSHA concludes that the limited coverage of the Cotton Dust Standard to these industries is not creating any significant economic impact on any substantial number of small businesses in these industries. See a discussion of the frequency of medical surveillance for these industries above in Ch.VI.5.g.

APPENDIX VI

SUMMARY OF LITIGATION IN THE AFTERMATH OF THE 1978 COTTON DUST STANDARD

The 1978 Cotton Dust Standard was to become effective September 4, 1978, but court challenges interfered with its implementation. Four cases were taken to the U.S. Court of Appeals and two to the Supreme Court of the United States:

Industry Segment	Court	Decision	Citation
Textile and Classing and Warehousing	U.S. Court of Appeals District of Columbia Circuit	The Court upheld the standard for the textile industry (yarn manufacturing, slashing and weaving) and for classing and warehousing. The Court held that OSHA had demonstrated the standard would substantially reduce a significant risk and was technologically and economically feasible.	AFL-CIO v. Marshall 617 F.2d 636 (1979)
Cottonseed Oil	U.S. Court of Appeals District of Columbia Circuit	The Court remanded the standard for cottonseed oil mills back to OSHA to demonstrate economic feasibility.	AFL-CIO v. Marshall 617 F.2d 636 (1979)
Ginning	U.S. Court of Appeals Fifth Circuit	The court vacated a separate standard for cotton ginning stating that the record did not demonstrate a significant risk of adverse health effects in the ginning sector.	Texas Ind. Ginners Assoc. v. Marshall 630 F.2d 398 (1980)
Classing and Warehousing	U.S. Supreme Court	The court stayed the application of the standard in these sectors.	Cotton Warehouse Association v. Marshall 449 U.S. 809 (1980)

Industry Segment	Court	Decision	Citation
Textiles	U.S. Supreme Court	The Supreme Court upheld the standard for the textile industry, except for the wage-retention provision, and also OSHA's decision that the cotton dust standard in textiles would substantially reduce a significant risk of byssinosis. It also upheld the Court of Appeals finding that the standard was technically and economically feasible. The Supreme Court rejected the contention that OSHA is to perform cost-benefit analysis in setting permissible exposure limits.	American Textile Manufacturers Institute, Inc. v. Donovan, 452 U.S. 490 (1981)
Textiles and Cottonseed Processing	U.S. Court of Appeals District of Columbia Circuit	The Court upheld the amended respirator and cottonseed processing provisions of the standard.	National Cottonseed Prods. Assoc. v. Brock 825 F.2d 482 (1987)

APPENDIX VII

APPLICATION OF THE COTTON DUST STANDARD (29 CFR 1910.1043) IN THE WORKPLACE

Processes Covered/Partially Covered by the Standard	Permissible Exposure Limit (micrograms/ cubic meter)[2]	Action Level (micrograms/cubic meter)[2]
Yarn Manufacturing and Cotton Opening and Washing	200	100
Slashing and Weaving	750	375
Wastehouses	500	250
Cottonseed Processing[1]	None Applicable	None Applicable
Waste Processing and Garnetting[1]	1000[3]	None Applicable

Industries/Processes Not Covered bv the Standard

1. Construction
2. Maritime
3. Harvesting or Ginning of Cotton
4. Handling or Processing of Knitted Materials[4]
5. Classing and Warehousing Operations[4]

[1] Only paragraphs (h) Medical Surveillance, (k)(2) through (4) Recordkeeping -Medical Records, and Appendices B, C, and D of the Standard apply in all workplaces where employees exposed to cotton dust engage in cottonseed processing or waste processing and garnetting operations.

[2] Airborne concentration of lint-free respirable cotton dust, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

[3] Waste processing and garnetting is covered by the 1000 micrograms/cubic meter exposure limit of 1910.1000. This exposure limit is interpreted as the respirable dust limit measured by a vertical elutriator.

[4] The standard does not apply to knitting, classing, or warehousing operations except that employers with these operations, if requested by NIOSH, shall grant NIOSH access to their employees and workplaces for exposure monitoring and medical examinations for purposes of a health study to be performed by NIOSH on a sampling basis.

Source: 29 CFR 1910.1043.

APPENDIX VIII

RESEARCH ON WASHED COTTON

Shortly after OSHA promulgated the Cotton Dust Standard, new interest focused on evaluating the potential role of washed cotton in prevention of byssinosis and related occupational respiratory disorders among cotton textile mill workers. Initially the standard completely exempted cotton that had been severely washed[1] at 100° C for 30 minutes in a batch kier system.[2] However, the resulting fiber was characterized by severe processing difficulties in textile manufacturing.

In 1980, a research program was initiated to evaluate the potential effectiveness of less severe washing of cotton. Consequent to a special Congressional appropriation to the U.S. Department of Agriculture (USDA) beginning in 1980, research was conducted under the auspices of a tripartite (Industry/Government/Union) Task Force on Washed Cotton Evaluation (subsequently renamed the Task Force for Byssinosis Prevention) to evaluate washed cotton as a potential means of preventing byssinosis.

Along with NIOSH, member organizations in this partnership included the USDA, the Amalgamated Clothing and Textile Workers Union, the American Textile Manufacturers Institute, Cotton Incorporated, and the National Cotton Council of America. The washed cotton research completed by these cooperators during the early years of the partnership proved of great value to OSHA in its

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[1] Cotton that is "thoroughly washed in hot water" and "known in the cotton textile trade as purified or dyed." as quoted in 43 Federal Register, 1978, p. 27351.

[2] The batch kier system is used for commercial washing operations for cotton. The modern batch kier systems wash cotton using sequential steps that involve opening and cleaning, preveting and cakemaking, kier washing and rinsing, centrifugation, and drying and baling.

review of the original Cotton Dust Standard and its promulgation of a revised standard in 1985.

In the 1978 standard, OSHA had exempted from coverage of the standard cotton "thoroughly washed in hot water" and "known in the cotton textile trade as purified or dyed."[3] This provision was based on studies[4,5,6,7,8] that demonstrated that washing cotton in such a manner significantly reduced or eliminated the biological effects of cotton dust.

Studies on the effectiveness of washing cotton continued after promulgation of the 1978 standard. In 1985, OSHA revised the 1978 exemption, providing for a

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[3] 43 Federal Register, 1979, p. 27351.

[4] M. A. El-Batawi, et. al., "An Epidemiological Study on the Etiological Factors in Byssinosis," International Archives Fur Gerwerbepath Gewerberhyg, 1962, Vol. 19, pp. 393-402, as cited in National Institute for Occupational Safety and Health (NIOSH), "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," the Task Force for Byssinosis Prevention (formerly the Industry/Government/Union Task Force for Washed Cotton Evaluation), U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health Division of Respiratory Disease Studies, August 1995, DHHS (NIOSH) Publication No. 95-113.

[5] R. S. F. Schilling, E. C. Vigliani, B. Lammers, F. Valic, and J. C. Gilson, A Report on a Conference on Byssinosis, 1963, in: XIVth International Congress of Occupational Health, Vol. II, Excerpta Medica International Congress Series No. 62, pp. 137-145, as cited in NIOSH, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

[6] M. McDermott, J. W. Skidmore, and J. Edwards, "The Acute Physiological, Immunological And Pharmacological Effects Of Inhaled Cotton Dust In Normal Subjects," 1968, in: Proceedings of the International Conference on Respiratory Disease in Textile Workers, Alicante, Spain, pp. 133-136, as cited in NIOSH, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

[7] M. McDermott, "Lung Airways Resistance Changes Due To The Inhalation of Dusts and Gases," (Abstract), Respiration, 1969, Vol. 26, pp. 242-243, as cited in NIOSH, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

[8] J. A. Merchant, J. C. Lumsden, K. H. Kilburn, V. H. Germino, J. D. Hamilton, and W. S. Lynn et al., "Preprocessing Cotton to Prevent Byssinosis," British Journal of Industrial Medicine, 1973, Vol. 30, pp. 237-247, as cited in NIOSH, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

complete exemption only for "medical grade (USP) cotton, cotton that has been scoured, bleached and dyed, and mercurized yarn." The 1985 revision also included partial exemptions for certain mildly washed cotton (cotton washed in a continuous batt system or rayon rinse system).[9] However, according to the Task Force, the commercial availability of continuous batt systems and rayon rinse systems was limited. There were no exemptions in the 1985 revision for cotton that is washed mildly in a batch kier system because there was a lack of evidence that it prevented health problems. Partly because of the limited availability of continuous systems for washing cotton and the potential availability of production capacity on modern batch kier systems, OSHA solicited additional research to evaluate batch systems further.

Task Force studies demonstrated that mild washing (essentially water rinsing) of cotton in a continuous batt or rayon rinse system physically removes dust from the cotton and also markedly reduces adverse airway response to residual dust.[10] In contrast, card-generated dust from cotton that was mildly washed in a now-outmoded batch kier washing system (though much less potent than dust from unwashed cotton) was found in some cases to retain measurable airway activity.[11] The variable results observed in the early batch kier washing studies were attributed to channeling of wash and rinse solutions through the cotton, which prevented thorough washing of the cotton fiber. Channeling was caused by nonuniform hand loading directly from the bale without mechanical opening,

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[9] 29 C.F.R. §§1910.1043(n)(4) & (5), 1998.

[10] P. J. Wakelyn, R. R. Jacobs, and I. W. Kirk, (eds.), "Washed Cotton: Washing Techniques, Processing Characteristics, and Health Effects," 1986, New Orleans, LA: U.S. Department of Agriculture, Agricultural Research Service.

[11] R. M. Castellan, "Evaluation of Acute Human Airway Toxicity Of Standard And Washed Cotton Dusts," in P. J. Wakelyn, R. R. Jacobs, I. W. Kirk, (eds.) Washed cotton: Washing Techniques, Processing Characteristics, and Health Effects, 1986, New Orleans, LA: U.S. Department of Agriculture, Agricultural Research Service, pp. 41-52.

cleaning, or pre-wetting.[12]

The Task Force continued to study the effect of washing cotton in modern batch kier systems. According to the Task Force, several studies[13] demonstrate that mildly washing cotton in modern batch kier systems is as effective in reducing respiratory disease as the already partially exempted continuous batt process by reducing the dust generating capacity of the washed cotton. In addition, this batch kier washing resulted in a statistically significant 19- to 55-fold reduction of endotoxin concentration in card-generated elutriated dust (compared with dust from the unwashed cotton), based on blinded endotoxin assays from the NIOSH laboratory, which has demonstrated reproducibility of its standardized endotoxin assay procedures over the period covered by all the relevant studies.[14]

On the basis of human ventilatory responses to experimental exposures to dust from this washed cotton, Jacobs and colleagues concluded that their results "suggest that modern batch-kier systems can effectively remove the acute pulmonary toxicity of cottons washed at 60°C and a 40:1 water-to-fiber ratio."[15]

In 1995, on the basis of observations and the results of controlled exposures of human volunteers, the Task Force concluded that mild washing of cotton in

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[12] National Institute for Occupational Safety and Health (NIOSH), "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

[13] H. H. Perkins Jr., and R. J. Berni, "Washing Cotton By Batch Processes," Textile Respiratory Journal, 1991, Vol. 61, pp. 39-46, and R. R Jacobs, B. Boehlecke, H. H. Perkins Jr., and D. T. W. Chun, "Evaluation Of The Acute Response Aerosols Of Dust From Batch Kier Washed Cotton. In: L. N. Domelsmith, R. R. Jacobs, P. J. Wakelyn, (eds.) Cotton Dust—Proceedings of the Seventeenth Cotton Dust Research Conference, 1993, Memphis, TN: National Cotton Council, pp. 274-278 and H. H. Perkins, Jr. and S. A. Olenchock, "Washing Cotton By Batch Processes To Control Dust And Endotoxin," Annals of Agricultural Environmental Medicine, 1995, Vol. 2, pp. 1-7, as cited in NIOSH, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," 1995.

[14] Perkins and Olenchock, 1995.

[15] Jacobs et al., 1993.

modern batch kier systems will prevent the acute respiratory effects of occupational exposure to cotton dust.[16] Because results of epidemiological observations of cotton textile mill workers indicated a significant association between acute and chronic effects, the Task Force further concluded that mild washing of cotton in modern batch kier systems can also be expected to prevent the chronic effects of occupational exposure to cotton dust. The Task Force also made other recommendations intended to encourage voluntary substitution of washed cotton for unwashed cotton as a means for reducing potential risk of occupational respiratory disorders among workers exposed to cotton dust.[17]

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[16] Ibid.

[17] Ibid.

APPENDIX IX

NEW DUST CONTROL TECHNOLOGIES IN TEXTILE MACHINERY AND AIR HANDLING EQUIPMENT

Textile Machinery

U.S. textile machinery manufacturers developed new technology to rebuild old equipment such as new cards and conversion from shuttle to shuttleless looms. Cards can be completely rebuilt with cylinder speeds increased and setting accuracy improved. A company can increase its productivity by almost 70 percent by converting conventional shuttle looms to air-jet looms. Loom conversion costs only 15 to 25 percent the price of a new loom.[1]

The following list provides some details about a sample of the new machinery available for use by the textile industry:

- HSR 1000 is a new drawframe design by Trutzschler GmbH that has a new cleaning system for suction on top rolls, carried out by plastic nozzles in the drafting zone. Other dust producing areas like the calender rolls and measuring frames also have suction. The machine can connect directly to central suction or to a collection box with large filtering capacity, thus reducing dust exposure for workers.[2]

- Ro-We-Mat 670 Roving Frame machine designed by Zinser has low maintenance drive, control systems, and fully integrated doffer. Cleaning

[1] U.S. Congress, Office of Technology Assessment, "The U.S. Textile and Apparel Industry: A Revolution in Progress -- Special Report," OTA-TET-332, Washington DC, U.S. Government Printing Office, April 1987, p. 76.

[2] Trutzschler GmbH, "Trutzschler: HSR 1000 Drawframe," Textile World, April 1998, pp. 41-44.

devices for flyer table and suction plus an optional suction cleaning system for the drafting section allow for these areas stay clean and minimize additional cleaning.[3]

- LTG installed the first system to reduce energy in a weaveroom around 1988. It reduced relative humidity and lowered air volume required to condition the room. The modern LTG WeaveDirect system requires reduced air volume and energy savings can approach 50 percent, with an increase in efficiency, product quality and cleaner weaving. Unlike a traditional weaveroom cleaning system which causes the dust and fly to rise above the loom, the WeaveDirect system pushes dust and fly downward and out of the breathing zone. The WeaveDirect system can also be installed in older mills to increase the humidity at the looms. It can also be used when additional machines are being installed and the present air washer is too small to handle the increased load.[4]

Air-Handling Equipment

Air handling is a crucial part of the textile business because of the need to remove dust from ambient air and lower exposure levels for workers. Air handling suppliers not only meet OSHA standards for particulate matter but continue to produce improved machinery that is more reliable and easier to repair than before.[5] Most of the new equipment is energy and space-efficient resulting in considerable cost savings, in addition to providing safer and cleaner work environments.[6] The list

[3] S. Weisser, "Zinser: Ro-We-Mat 670 Roving Frame," Textile World, April 1998, pp. 44-45.

[4] G. Seyffer, "LTG: WeaveDirect Loom Conditioning System," Textile World, April 1998, pp. 60-61.

[5] S. D. Barker, "Technology Advances Spur On Air Handling," Textile World, January 1994, pp. 59-63.

[6] Ibid.

below provides some details and examples of a sample of air handling technology advances:[7]

- Electro-Jet, Spain (PSP Marketing Inc.), Charlotte, NC, produces traveling cleaners for spinning, winding, twisting and other processes.

- Industrial Air Inc., Greensboro, NC, produces a new easy-access dust filter. The new design is more compact, freeing up floor space and offering greater access for maintenance. Another offering is the Fiber Separator, a self-cleaning prefilter that has positive automatic backwash to remove collected fiber and dust.

- Ernst Jacobi GmbH, Germany (Symtech Inc.), Spartanburg, SC, markets an automatic cleaner model KWE 600, a compact and lightweight system featuring direct and dust-free waste discharge into a central collection unit or machine filterbox. Symtech Inc. also produces the hi-vac compact unit Samos, including side channel blower, filters, receiver, and control panel. It is frame-mounted for general cleaning in spinning and weaving mills.

- According to Neuenhauser Maschinenbau GmbH & Co. KG, Germany (Hubtex of North America Inc.), Spartanburg, SC, its overhead traveling cleaner, Top Duct, a filterless cleaner for spinning machinery and the overhead traveling cleaner, Texpro 2, are economical solutions for winding and twisting machinery, and new to the U.S. market in 1998. The Top Duct FSN/FTN cleaner has two separate circuits for air blowing and suction. After absorbing large volumes of dust, the cleaner still can be used to full capacity because the dust is not collected in the cleaner on the filters. Instead it is directly conducted away to the central collecting station via the suction duct. The Texpro 2 cleaner is used mainly for

[7] America's Textile International, "ATME-I '97 Serves Up The Latest Technology," http://www.billian.com/textiles/march1997/atmei.html, downloaded May 12, 1998.

winding and twisting machines and is equipped with a maintenance-free belt drive system. The transport system Autoflow features the Dispospin Z100 central palletizer equipped for handling residual quantities.

- Pneumafil Corp., Charlotte, NC, produces a new high-efficiency, higher capacity, self-cleaning filter that features a greatly simplified cleaning system. Pneumafil Corp.'s Versafilter, introduced at ATME-I '96, is a self-cleaning filter adaptable to a variety of textile applications. Designed for lighter dust and lint loads, it is suitable for mounting on a wall or suspending from a ceiling for spot cleaning. It features a simple, low-maintenance cleaning mechanism and offers lowest filtration cost.

- Sohler Airtex GmbH, Germany (Batson Yarn and Fabrics Machinery Group Inc.), Greenville, SC, developed a new-generation Euroclean system for spinning that introduces an overhead, light weight traveling cleaner. The machinery gives high value dust-free delivery and is flexible so that a tailor-made solution can be assigned to every phase of automation.

- Upkeeper Corp., Charlotte, NC, makes an industrial blower/cleaner with 2.5-inch and 4-inch diameter flex hose attachments that transfer debris into a 55-gallon container.

APPENDIX X

DETAILS OF COMMENTS PROVIDED FOR THE REVIEW OF THE COTTON DUST STANDARD

Comments submitted to the Docket in response to OSHA's request for input to this regulatory review of the Cotton Dust Standard contained comments that addressed specific issues. The following text expands on Chapter VI and cites comments on each of the six issues discussed the most by the commenters.

1. Washed Cotton

Paragraph (n) of the standard exempts certain types of washed cotton from some requirements of the standard. Paragraph (n) includes complete or partial exemptions for medical and dyed cotton, higher grade washed cotton washed in a continuous batt system or a rayon rinse system, and lower grade washed cotton similarly prepared. However, under the present standard, mild washing in a modern batch kier system is not an acceptable method to wash cotton.

Jane Robens, Chair, Task Force for Byssinosis Prevention,[1] United States Department of Agriculture, submitted comments supporting the recommendations of the Task Force for Byssinosis Prevention on the washing of cotton,[2] saying that modification of the Cotton Dust Standard to allow mild washing in batch kier systems would benefit worker health and increase the flexibility of the OSHA

[1] The Tripartite (Industry/Government/Union) Task Force on Washed Cotton Evaluation (subsequently renamed the Task Force for Byssinosis Prevention) evaluated washed cotton as a potential means of preventing byssinosis. Member organizations in this partnership included the USDA, NIOSH, the Amalgamated Clothing and Textile Workers Union (ACTWU, now UNITE), the American Textile Manufacturers Institute, Cotton Incorporated, and the National Cotton Council of America.

[2] National Institute for Occupational Safety and Health "Higher Grade Washed Cotton," NIOSH CIB56, August 1, 1995 (OSHA Docket H-052 F, Exhibit 5).

standard.[3] A NIOSH spokesperson recommended that OSHA adopt the NIOSH position on acceptable methods for washing cotton.[4]

A representative from the National Cotton Council (NCC) provided recommendations for changes in washed cotton regulation to allow mild washing in batch-kier systems. NCC requested that OSHA make the changes recommended in the NIOSH document, saying that "(s)uch a modification represents an opportunity to benefit worker health, while, at the same time increasing the flexibility of the OSHA standard." NCC specifically requested that OSHA make the changes through promulgation of a final rule.

The Task Force for Byssinosis Prevention recommends that OSHA should add mild washing in a modern batch kier system as an acceptable method to wash cotton under the 1985 Cotton Dust Standard. Specifically, the pertinent part of the Cotton Dust Standard [29 C.F.R. 1910.1043(n)] should be amended through the following additions in boldface type:

(n) Washed cotton --

(4) *Higher grade washed cotton.* The handling and processing of cotton classed as "low middling light spotted or better" **(color grade code 52 or better and leaf grade code 5 or better according to the current USDA classification system begun in 1993)** which has been washed:

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[3] Letter from Jane Robens, U.S. Department of Agriculture (USDA,) to Joe Dear, Assistant Secretary of Labor for OSHA, U.S. Department of Agriculture (OSHA Docket H-052 F, Exhibit 4).

[4] National Institute for Occupational Safety and Health, "Washed Cotton: A Review and Recommendations Regarding Batch Kier Washed Cotton," The Task Force for Byssinosis Prevention (formerly the Industry/Government/Union Task Force for Washed Cotton Evaluation), U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention National Institute for Occupational Safety and Health Division of Respiratory Disease Studies, August 1995, DHHS (NIOSH) Publication No. 95-113.

(A) **On a continuous batt system or a rayon rinse system**

(i) with water,

(ii) at a temperature of no less than 60 degrees C,

(iii) with a water-to-fiber ratio of no less than 40:1, and

(iv) with bacterial levels in the wash water controlled to limit bacterial contamination of the cotton.

(B) **On a batch kier washing system**

(i) with water,

(ii) with cotton fiber mechanically opened and thoroughly prewet before forming the cake,

(iii) for low-temperature process, at a temperature of no less than 60 degrees C with a water-to-fiber ratio of no less than 40:1; or, for high-temperature process at a temperature of no less than 93 degrees C with a water-to-fiber ratio of no less than 15:1, and

(iv) with a minimum of one wash cycle followed by two rinse cycles for each batch, using fresh water in each cycle.

2. Respirators

Use of Respirators. The current standard permits the use of PAPRs equipped with high-efficiency particulate filters at cotton dust exposures greater than 100 times the applicable PEL. NIOSH recommends that an assigned protection factor (APF) of 25 be used on PAPRs with particulate filters. For PAPRs equipped with a tight-fitting face-piece and a high efficiency particulate filter NIOSH recommends use of an APF of 50.[5]

[5] Paul Schulte, Director, Education and Information Division, National Institute for Occupational Safety and Health, at OSHA Public Meeting, comments submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-3).

Use of Respirators During Blow-Down/Blow-Off Operations. The current language in the standard[6] does not allow employees to stay in blow off and blow down areas unless their presence is absolutely necessary. ATMI recommends that the language of the standard be changed to allow employees to wear suitable respirators and stay in the work areas during such operations.[7] ATMI believes that as long as employees are fitted with appropriate respirators, they are adequately protected. Further, use of such respirators until dust levels return to normal would better protect the employees. ATMI believes that by decreasing stops in production, the textile industry would be more competitive in the global marketplace.

3. **Monitoring**

Two exposure monitoring issues were discussed in the comments -- the frequency of air monitoring and rules for alternative sampling devices.

Frequency of Air Sampling. Both ATMI and NCC recommend that instead of annual air-sampling, as required in 1910.1043 (d)(3)(i),[8] testing should be allowed every two years for areas below the action level. ATMI states: "We believe annual testing in areas below the action level is not necessary and costly."[9] NCC comments that annual monitoring for those areas that are at or below the action level "is not necessary and is an unneeded cost," and that "this is consistent with

[6] Section 1910.1043(g)(1) states: "Compressed air "blow down" cleaning shall be prohibited where alternative means are feasible. Where compressed air is used for cleaning, the employees performing the "blow down" or "blow off" shall wear suitable respirators. Employees whose presence is not required to perform "blow down" or "blow off" shall be required to leave the area affected by the "blow down" or "blow off" during this cleaning operation."

[7] Carlos Moore, Executive Vice President, American Textile Manufacturing Institute, OSHA Public Meeting, comments submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-1).

[8] Section 1910.1043(d)(3)(i) states: "[i]f the initial monitoring required by paragraph (d)(2) of this section or any subsequent monitoring reveals employee exposure to be at or below the permissible exposure limit, the employer shall repeat the monitoring for those employees at least annually."

[9] Moore, ATMI.

other parts of the cotton dust standard where OSHA has reduced requirements when exposures are at or below the action level."[10]

ATMI believes that frequent sampling in areas below the action level is unnecessary because the standard also requires maintenance and verification of mechanical ventilation systems and the newer computer controlled filtration systems automatically make adjustments to ensure proper working conditions. NCC agrees with ATMI and comments "if proper maintenance and verification systems are in place, there is no need to perform sampling in areas below the cotton dust action level more frequently than every 2 years."

Both ATMI and NCC comment that employers should conduct sampling whenever there is a change in production, processes, or controls used -- as the standard currently mandates.

Alternative Sampling Devices. Section 1910.1043(d)(1)(iii)(A) permits the use of an alternative sampling device if "[i]t collects respirable particulates in the same range as the vertical elutriator (approximately 15 microns).

NIOSH[11] suggests this language be changed as follows: "It collects thoracic respirable particulates in the same range as the vertical elutriator (approximately 15 microns) or other sampler with 50% sampling efficiency at approximately 10 micrometers aerodynamic equivalent diameter." According to NIOSH, such a change would make the language of the standard more consistent with the language used by ACGIH. NIOSH also recommends that OSHA change the term "respirable particulates" to "thoracic particulates" throughout the standard.

[10] Phillip Wakelyn, Senior Scientist, National Cotton Council of America, comments submitted to OSHA, September 21, 1998 (OSHA Docket H-052 F, Exhibit 3-5).

[11] Schulte, NIOSH.

4. Medical Surveillance

Each employer covered by the standard is required to institute a program of medical surveillance for all employees exposed to cotton dust that includes pulmonary function measurement, including a determination of forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1), the FEV_1/FVC ratio, and the percentage that the measured values of FEV_1 and FVC differ from the predicted values. Periodic examinations for all employees are also required.

i. NIOSH recommends changing the 80 percent cut-point for spirometry tests, based on work by the American Thoracic Society.

ii. ATMI suggests adjusting the predicted FEV_1 and FVC values to include racial and ethnic group other than African Americans. ATMI also asks OSHA to update the Knudson tables.[12] NIOSH recommends that OSHA replace the Knudson tables with the NHANES III prediction values.[13] NCC wants OSHA to review the NHANES III data to determine if the Knudson tables should be changed instead of being replaced.[14]

iii. ATMI asks OSHA to exempt some populations from the medical surveillance requirement – mainly temporary workers, workers involved in short process trial runs, and office and administrative personnel.[15]

iv. NIOSH recommends that OSHA clarify which questionnaire of Appendix B is referred to by 1910.1043(h)(2)(ii) as the standardized questionnaire in the context of initial medical examinations.

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[12] Moore, ATMI.

[13] Schulte, NIOSH.

[14] Wakelyn, NCC (OSHA Docket H-052 F, Exhibit 3-5).

[15] Moore, ATMI.

v. NIOSH recommends re-examination and possible replacement of Appendices B-1, II, III, C, and D of the standard.

vi. NIOSH recommends that OSHA require all who conduct pulmonary function training to complete a NIOSH-approved training course in spirometry. NIOSH further recommends that, where state laws allow, qualified non-physician health care providers should also be permitted to administer the required examinations.

vii. NIOSH recommends the re-evaluation of an FEV_1 of less than 80 percent of predicted value as cut off point in spirometry tests. [16]

viii. NIOSH recommends tightening the timing requirement for spirometry testing. NIOSH points out that "published evidence indicates an incrementally increasing effect of cotton dust over a work shift of exposure,[17] suggesting that medical monitoring for an acute cotton dust effect would be more sensitive at 6 or more hours after the start of the shift than at the current minimum of 4 hours."

NIOSH also notes that with the advent of novel work shifts, the "sensitivity" of medical monitoring would be increased by eliminating the 10 hour limitation on the repeat test: "If a worker works 12 hours a day (i.e., for three days per week), his repeat testing should be permissible up to 12 hours after the work shift begins." NIOSH suggests that the medical monitoring would be more sensitive if the repeat testing were permitted only up to 30 minutes after cessation of exposure.

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[16] National Institute for Occupational Safety and Health, "Criteria for a Recommended Standard, Occupational Exposure to Respirable Coal Mine Dust," U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1995, Publication No. 95-106.

[17] J. A. Merchant, G. M. Halprin, A. R. Hudson, K. H. Kilburn, W. N. McKenzie, D. J. Hurst, and P. Bermazohn, "Responses to Cotton Dust," Archives of Environmental Medicine, 1975, Vol. 30, pp. 222-229.

ix. NIOSH recommends that OSHA provide clarification on determining a worker's byssinosis grade. NIOSH comments that the current standard provides no guidance regarding how to use the questionnaire responses specifically to make a Schilling classification for grade of byssinosis. NIOSH received inquiries on this matter and recommends that OSHA provide detailed guidance for byssinosis classification. NIOSH would be willing to assist OSHA in developing guidance on this issue.

x. NIOSH contends that the standard gives no guidance for determining "significant change," and that such guidance could be provided from a 1995 NIOSH publication.[18] The recommended NIOSH approach to interpretation of longitudinal test performance has been presented in more detail recently.[19]

xi. NIOSH recommends that physicians receive additional information about the patients they see. NIOSH further recommends that the standard also "specify that the physician be provided with information on the affected employee's industry and work area as they relate to determining applicable exposure control and medical monitoring requirements specified in 29 C.F.R. 1910.1043."

NIOSH also recommends additional information be provided by the physician to the employer, which should include (1) the physician's recommended restriction on the worker's exposure to cotton dust (or any other agents in the workplace) and on the worker's use of personal respiratory protective devices and/or protective clothing; (2) a statement that the worker has been informed about the results of

[18] National Institute for Occupational Safety and Health, "Criteria for a Recommended Standard, Occupational Exposure to Respirable Coal Mine Dust," U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1995, Publication No. 95-106.

[19] J. L. Hankinson and G. R. Wagner, "Medical Screening Using Periodic Spirometry for Detection of Chronic Lung Disease," in: E. A. Eisen (ed.), Occupational Medicine, Spirometry, Vol. 8, No. 2, Philadelphia, Hanley and Belfus, Inc., pp. 353-361, as cited in comments submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-3) by Paul Schulte, Director, Education and Information Division, National Institute for Occupational Safety and Health, OSHA Public Meeting.

the medical examination and of any medical conditions that should have further evaluation and treatment; and (3) to protect confidentiality, a signed authorization from the worker permitting the employer to receive the report if it reveals specific findings or diagnoses.

xii. NCC requests clarification from OSHA on the required frequency of medical examination for several categories of workers. The first is workers whose FEV1 is less than 10 percent of the predicted value. NCC interprets the provision in Section 1910.1043(h)(3)(iii) as mandating that the examination be given every 6 months. NCC requests that OSHA provide further clarification by either: (1) amending paragraph (h)(3)(iii) of the cotton dust standard to clarify that employers do not have to provide detailed pulmonary examinations to these individuals every six months; or (2) issuing a compliance directive or amend Directive CPL 2-2.31 to reflect the guidance in the OSHA letter to ELB Associates.

NCC believes that requiring an examination every 6 months is "counterproductive from a medical viewpoint, costly and time consuming." NCC believes that individuals who register an FEV_1 less than 60 percent of predicted should be referred to a qualified physician initially; however, any subsequent medical surveillance should be determined on a case-by-case basis determined by "condition," "functional status," and "good medical practice."

OSHA, however, wrote an interpretive letter to Ennis, Lumsden, Boyleston & Associates, Inc. (ELB Associates) on January 3, 1991, stating that "it was not the intent of the standard to require a detailed (sic) pulmonary examination every six months." NCC requests that OSHA provide further clarification.

NCC also believes that "spirometry measurement can be quite variable and 5 percent is too sensitive a criterion" to use as a benchmark for requiring medical surveillance every six months. NCC cites studies by Hankinson, Hankinson and

Wagner and by Ghio, Castellan et al. showing that variability across shift changes were significantly related to many factors and that the authors suggest that a "criteria for across-shift changes of approximately 8 percent for FEV_1" would be more appropriate.

NCC requests that OSHA change medical surveillance requirements for employees in cottonseed processing and waste processing operations. NCC states that "employers in cottonseed and waste operations indicate that they have performed medical surveillance of their workers for 10 or more years and see no change in the workers." NCC admits that it has no concrete data to support this. Nevertheless, NCC recommends that OSHA either remove medical surveillance requirements or only require such testing every 5 to 7 years, if NCC can provide data showing that workers did not exhibit acute reactivity or chronic effects. When such information is available, NCC states that it will submit it to OSHA.

NCC believes that "spirometry measurement can be quite variable and 5 percent is too sensitive a criterion" to use as a benchmark for requiring medical surveillance every six months. NCC cites studies by Hankinson, Hankinson and Wagner and by Ghio, Castellan et al. showing that variability across shift changes were significantly related to many factors and that the authors suggest that a "criteria for across-shift changes of approximately 8 percent for FEV_1" would be more appropriate.

5. Permissible Exposure Limits (PELs)

i. The PEL for Yarn Manufacturing Workers. According to NIOSH, recent studies demonstrating the increased susceptibility of smokers to adverse health effects from exposure to cotton dust suggest that OSHA should review new information in preparation for the possibility of developing a revised PEL to further protect all workers exposed to cotton dust. The studies referred to by NIOSH were conducted in 1991 and 1994 for

workers in the yarn manufacturing areas. (See Appendix IV: Health Hazards Associated With Cotton Dust – "Studies on Synergism Between Smoking and Cotton Dust Exposure.")

ii. Adjusting the PEL to Account for Extended and Novel Work Shifts. NIOSH recommends that "the PEL for cotton dust be adjusted downward proportionately to maintain protection of workers' health" for employees that are working extended or novel work shifts (e.g., 12 hours/day for 3 days/week).

NIOSH recently published animal research designed to study whether the PEL should be adjusted to account for extended or novel work shifts, which found a strong linear relationship between acute pulmonary responses and total cotton dust exposure.[20, 21] According to NIOSH, the research suggested "that the current PEL for 8 hour shifts is inadequate for extended work shifts and should be lowered in relationship to the extra hours worked during a given day."[22]

At the Atlanta hearing, John Lopez, a certified industrial hygienist, suggested that OSHA examine the epidemiological data before taking any

[20] V. Castranova, V. A. Robinson, W. T. Goldsmith, N. A. Phillips, A. Afshari, and D. G. Frazer, "Cotton and Other Organic Dusts: Time Course of Pulmonary Responses to Inhalation of Cotton Dust in the Guinea Pig Animal Model," Journal of Cotton Science, 1998, Vol. 2, pp. 10-16, as cited in comments submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-3) by Paul Schulte, Director, Education and Information Division, National Institute for Occupational Safety and Health, OSHA Public Meeting.

[21] V. Castranova, V. A. Robinson, W. T. Goldsmith, N. A. Phillips, A. Afshari, and D. G. Frazer, "Pulmonary Inflammation of Guinea Pigs in Response to Inhalation of Cotton Dust: Effect of Extended Exposure Day," in P. J. Wakelyn, and R. R. Jacobs (eds.) Proceedings of the 22nd Cotton and Organic Dusts Research Council, 1998, Memphis, TN: National Cotton Council, as cited in comments submitted August 31, 1998 (OSHA Docket H-052 F, Exhibit 3-3) by Paul Schulte, Director, Education and Information Division, National Institute for Occupational Safety and Health, OSHA Public Meeting.

[22] Schulte, NIOSH.

steps to lower the PEL. With respect to the PEL adjustment for extended and novel work shifts, Lopez observed that different regions and state plan states apply an inconsistent PEL to extended and novel work shift. He recommended that OSHA clarify its position on the PEL for such shifts.[23]

6. Frequency of training

Section 1910.1043(i) states: "The training program (for employees) shall be provided prior to initial assignment and shall be repeated annually for each employee exposed to cotton dust, when job assignments or work processes change and when employee performance indicates a need for retraining."

NCC comments that annual training for employees, as stated in 1910.1043 (i), is unnecessary. NCC complains that workers do not pay attention during annual training because they have heard the information before. NCC recommends that training be mandated when an employee is hired and thereafter when job assignments or work processes change and requests that OSHA modify the standard to remove the requirement that employees be trained annually.[24]

7. Comments Related to Small Business

The only comment to the docket or at Public Meetings related to small business came from Dr. Wakelyn of the National Cotton Council. He commented at the Washington, DC public meeting that the Cotton Dust Standard was sometimes difficult to understand and that OSHA should do something from an information and education standpoint, an outreach, and

[23] Occupational Safety and Health Administration, "Fact Findings Hearing Transcripts, July 24, 1998 (OSHA Docket H-052 F, Exhibit 8-X, p. 12-17).

[24] Wakelyn, NCC (OSHA Docket H-052 F, Exhibit 3-5).

particularly as it affects small business, to make sure that the people that are trying to enforce this standard understand it. He suggested that OSHA examine the recommendation of the Task Force for Byssinosis Prevention about allowing exemption for mildly washed cotton, which would allow small mills the flexibility of not having to meet all aspects of the current cotton dust standard. He also suggested that OSHA examine the possibility of relaxing the frequency of medical surveillance requirements for workers in the waste processing and garnetting sectors of the industry from two to five years. Since this testing costs the mills almost $4,000 to $5000, and the waste cotton and cotton seed oil mills are small businesses, relaxing the surveillance requirement "would help them in business," as their profit margins are not very large. Dr. Wakelyn said that he had not examined fully the health data on this issue.[25]

[25] Ibid.