

I. RECOMMENDATIONS FOR A FIBROUS GLASS STANDARD

The National Institute for Occupational Safety and Health recommends that employee exposure to fibrous glass be controlled in the workplace by adherence to the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour workday, 40-hour workweek over a normal working lifetime. Therefore, compliance with all sections of the standard should prevent adverse effects of fibrous glass on the health and safety of employees.

In developing these recommendations, the Institute proposes that two categories of fibrous glass be identified for control purposes. The delineation between categories is by fiber diameter, with 3.5 micrometers (μm) being the dividing line. The primary health effects associated with the larger diameter fibers involve skin, eye, and upper respiratory tract irritation, a relatively low incidence of fibrotic (lung) changes, and preliminary indications of a slight excess mortality risk due to nonmalignant respiratory diseases. In this regard, NIOSH considers the hazard potential of fibrous glass to be greater than that of nuisance dust, but less than that of coal dust or quartz. With small-diameter fibers, much less information on health effects is available. Experimental studies in animals have demonstrated carcinogenicity; however, with the test methods employed (implantation), it is not considered that these results, can be extrapolated directly to conditions of human exposure. On the basis of currently available information, NIOSH does not consider fibrous glass to be a substance that produces cancers as a result of occupational exposure. However, these smaller fibers can penetrate more deeply into the

lungs than larger fibers and until more definitive information is available, the possibility of potentially hazardous effects warrant special consideration. The recommended environmental levels are based on evidence in those instances where exposure to asbestos and fibrous glass can be compared and, considering the limitations and deficiencies of such data, fibrous glass seems to be considerably less hazardous than asbestos. In addition, although this criteria document addresses occupational exposure to fibrous glass, NIOSH considers that until more information is available, the recommended standard can also be applied to other man-made mineral fibers.

Fibrous glass is the name for a manufactured fiber in which the fiber-forming substance is glass. Glasses are a class of materials made from mixtures of silicon dioxide with oxides of various metals and other elements, that solidify from the molten state without crystallization. Table XV-1 lists several representative compositions of glasses. Synonyms for fibrous glass include fiberglass and glass fibers. A fiber is considered to be a particle with a length-to-diameter ratio of 3 to 1 or greater. An "action level" is defined as half the recommended time-weighted average (TWA) environmental limit. "Occupational exposure" is defined as exposure to airborne fibrous glass above the action level. In addition, because workers may be exposed to fibrous glass by dermal or eye contact occupational exposure includes contact with the skin and eyes to fibrous glass where it is manufactured, used, handled or stored. When environmental concentrations are at or below the action level, adherence to sections 1, 2(b), 4(c), and 8(b) is not required.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to fibrous glass shall be controlled so that no worker is exposed at an airborne concentration greater than 3,000,000 fibers per cubic meter of air (3 fibers per cubic centimeter of air) having a diameter equal to or less than 3.5 micrometers (μm) and a length equal to or greater than 10 micrometers determined as a time-weighted average (TWA) concentration for up to a 10-hour work shift in a 40-hour workweek; airborne concentrations determined as total fibrous glass shall be limited to a TWA concentration of 5 milligrams per cubic meter of air.

(b) Sampling and Analysis

Sampling in the work environment shall be performed by the method provided in Appendices I and III or by other methods with at least equivalent efficiency. Samples shall be analyzed by the methods provided in Appendices II and IV or by methods demonstrated to be at least equivalent in accuracy, precision, and sensitivity.

Section 2 - Medical

Medical surveillance shall be made available to employees as outlined below:

(a) Preplacement examinations shall include at least:

(1) Comprehensive medical and work histories with special emphasis directed towards evidence of acute or chronic skin conditions and pulmonary disease and prior exposures in dusty occupations such as those involving exposure to silica, coal dust, and asbestos.

(2) Physical examination giving particular attention to the skin and respiratory system. Examinations should include simple tests for dermographism, and such tests of pulmonary function as FEV 1 and FVC when considered to be appropriate by the responsible physician. Eye examinations should also be considered when appropriate.

(3) For those workers exposed above the action level to fibers less than 3.5 μm in diameter, more specific tests shall be considered such as chest roentgenograms, pulmonary function tests such as FEV 1 and FVC, and others related to the detection of chronic lung disease including primary tuberculosis.

(4) An evaluation of the worker's ability to use positive and negative pressure respirators and to function under partial oxygen deprivation.

(b) Periodic examinations shall be made available at least on an annual basis or at some other more frequent intervals to be determined by the responsible physician. These examinations shall include at least:

(1) Interim medical and work histories.

(2) Physical examination as outlined in (a)(2) and (a)(3) above.

(c) During examinations, applicants or employees having medical conditions which would be directly or indirectly aggravated by exposure to fibrous glass shall be counseled on the increased risk of impairment of their health from working with this substance.

(d) Initial medical examinations shall be made available to all workers within 6 months after the promulgation of a standard based on these recommendations.

(e) Pertinent medical records shall be maintained for all employees exposed to fibrous glass in the workplace. Such records shall be retained for at least 30 years after termination of employment. These records shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare; of the Secretary of Labor; of the employer; and of the employee or former employee.

Section 3 - Labeling and Posting

(a) The following caution sign shall be affixed or posted in a readily visible location at or near entrances to areas or on processing or other equipment where there is occupational exposure to fibrous glass:

FIBROUS GLASS

CAUTION

AVOID BREATHING DUST

Thoroughly wash exposed skin surfaces and flush the eyes after handling.

All warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Illiterate workers and workers reading languages other than those used on posted signs shall receive information regarding hazardous areas and shall be informed of instructions printed on signs.

Section 4 - Personal Protective Equipment and Clothing

Engineering controls shall be used if needed to maintain fibrous glass concentrations at or below the limits recommended in Section 1. When necessary, engineering controls shall be supplemented by the use of personal protective equipment. Requirements for personal protective equipment shall be as approved under provisions of 29 CFR 1910, Subpart I.

(a) Skin Protection

Protective clothing shall be worn to prevent fibrous glass contact with skin especially hands, arms, neck, and underarms.

(b) Eye Protection

Safety goggles or face shields and goggles shall be worn during tear-out or blowing operations or when applying fibrous glass materials overhead. They should be used in all areas where there is a likelihood that airborne glass fibers may contact the eyes.

(c) Respiratory Protection

(1) The only situations in which compliance with the recommended environmental limit may be achieved by the use of respirators are:

(A) During the time necessary to install or test required engineering controls; or

(B) In situations such as during the performance of nonroutine construction, demolition, maintenance, or repair activities when air concentrations of fibrous glass may exceed the recommended environmental limit. Respiratory protection is necessary in those operations where high volumes of dust are generated and where adherence to environmental exposure limits cannot be achieved by engineering controls.

(2) When use of respirators is permitted, they shall be selected and used in accordance with the following requirements.

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(B) When wearing of respirators is required, the employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator in a proper manner. The respiratory protective devices in conformance with Table I-1 shall comply with the standards approved by NIOSH or the Mining Enforcement and Safety Administration (MESA) as specified under the provisions of 30 CFR 11.

(C) For the purpose of determining the type of respirator to be used, the employer shall measure the concentrations of fibrous glass in the workplace initially and thereafter whenever control, process, operation, worksite, or climate changes occur that are likely to increase the concentration of airborne fibrous glass. This requirement does not apply when only self-contained or combination supplied-air and self-contained positive pressure respirators are used.

(D) The employer shall ensure that employees are properly instructed at least annually through training and drills on the use of respirators assigned to them and on how to test for leakage, proper fit, and proper operation.

(E) Respirators specified in Table I-1 for use in atmospheres of higher concentrations of airborne fibrous glass may be used in atmospheres of lower concentrations.

(F) The employer shall establish and conduct a program of cleaning, sanitizing, inspecting, maintaining, repairing, and

storing respirators to ensure that employees are provided with clean respirators that are in good operating condition.

(G) The employer shall periodically monitor the use of respirators to ensure that the proper type of respirator is worn, to evaluate the effectiveness of the respiratory protection program, and to eliminate any deficiencies in use and care of respirators.

(H) Respirators shall be easily accessible and employees shall be informed of their location.

TABLE I-1

RESPIRATOR SELECTION GUIDE
FOR FIBROUS GLASS

Fibrous Glass Concentration	Respirator Type Approved Under Provisions of 30 CFR 11
Less than or equal to 15,000,000 fibers/cu m	(1) A dust and mist respirator.
Less than or equal to 30,000,000 fibers/cu m	(1) A dust and mist respirator except single-use or quarter-mask respirator; or (2) A high efficiency particulate filter respirator; or (3) A supplied-air respirator; or (4) A self-contained breathing apparatus.
Less than or equal to 150,000,000 fibers/cu m	(1) A high-efficiency particulate filter respirator with full facepiece; or (2) A supplied-air respirator with a full facepiece, helmet, or hood; or (3) A self-contained breathing apparatus with a full facepiece.
Less than or equal to 3,000,000,000 fibers/cu m	(1) A powered air-purifying respirator with a high efficiency particulate filter and full facepiece; or (2) A type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous flow mode.
Greater than 3,000,000,000 fibers/cu m.	(1) A combination respirator which includes a type C supplied-air respirator operated in pressure-demand or continuous flow mode; or

TABLE I-1 (CONTINUED)

RESPIRATOR SELECTION GUIDE
FOR FIBROUS GLASS

Fibrous Glass Concentration	Respirator Type Approved Under Provisions of 30 CFR 11
Greater than 3,000,000,000 fibers/cu m.	(2) Self-contained breathing apparatus with full facepiece, pressure-demand or other positive pressure mode.

Section 5 - Informing Employees of Hazards from Fibrous Glass

(a) Workers initially assigned or reassigned to jobs involving occupational exposure to fibrous glass shall be informed of the hazards, symptoms of overexposure (including information on the characteristics of onset and stages of illness), appropriate procedures to be taken in the event of an emergency, precautions to ensure safe use, and to minimize exposure. Workers shall be advised of the availability of relevant information, including that prescribed in (c) below. This information shall be accessible to each worker occupationally exposed to fibrous glass.

(b) A continuing education program, conducted at least annually by a person or persons qualified by experience or special training, shall be instituted to ensure that all workers have current knowledge of job hazards, proper maintenance procedures and cleanup methods, and that they know how to use respirators correctly. The education program shall include a description of the general nature of the medical surveillance procedures

and why it is advantageous to the worker to undergo medical examinations.

(c) The required information shall be recorded on a "Material Safety Data Sheet" as specified in Appendix V or on any other form approved for the purpose by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices and Control Procedures

(a) Exhaust Systems

Where a local exhaust ventilation and collection system is used, it shall be designed and maintained to prevent the accumulation of fibrous glass.

(1) Where materials containing fibrous glass are mechanically worked by power equipment, exhaust ventilation shall be used to limit airborne fibrous glass.

(2) Air from exhaust ventilation systems shall not be recirculated into the workroom.

(b) General Work Practices and Environmental Controls

A variety of situations exist that involve potential exposure to fibrous glass. To specifically detail work practices and controls for each situation would be impractical. In operations where there is occupational exposure to fibrous glass, employers shall develop comprehensive work practices relevant to the specific situations encountered. These practices should follow the recommended guidelines identified in this section, in Chapter VI, and in Appendix VI. Generally, occupational exposure to fibrous glass can occur in either stationary operations or in operations that regularly occur at different (nonstationary) locations. The general

principles to follow in these operations have been identified and are given below.

(1) Stationary Operations

Operations that involve regular handling of fibrous glass at a fixed location, such as manufacturing, shall be controlled by using appropriate enclosures and well-designed local exhaust systems.

Procedures shall be established that minimize the accumulation of waste dust or scrap materials. Specific procedures for containment of dust and handling of contained materials shall be instituted so that the possibility of secondary air contamination is minimized. Cleanup procedures based on wetting the material and use of vacuum-cleaning for pickup shall be employed.

(2) Nonstationary Operations

Operations that involve short-term or transient work involving fibrous glass at different locations present unique circumstances for exposure. Employers shall evaluate the various aspects of exposure that could result from work involving fibrous glass at multiple locations, and identify appropriate work practices or controls suitable to the operation. Where possible, use of portable exhaust ventilation is recommended. Respirators may be necessary when engineering controls or work procedures cannot maintain airborne fibrous glass levels below the recommended environmental limit. Appropriate cleanup procedures, aimed at minimizing the airborne concentration of fibrous glass, shall be used. These procedures include wet-sweeping and vacuum-cleaning. Care shall be taken in nonstationary operations to minimize the effects of meteorologic conditions, such as wind, in increasing airborne concentrations of fibrous

glass. Enclosures or temporary curtains shall be considered to control the amount and velocity of air moving through the workplace.

Section 7 - Sanitation Practices

(a) Plant sanitation shall meet the requirements of 29 CFR 1910.141.

(b) Appropriate locker rooms shall be available for changing into required protective clothing in accordance with 29 CFR 1910.141(e).

(c) Protective clothing shall be washed, dried, and inspected before reissue or reuse.

(d) The employer shall inform workers exposed to fibrous glass of the importance of laundering work clothes separately from other clothing. In operations where clothes are laundered under contract, contractors shall be informed of the hazards of laundering clothes contaminated with fibrous glass.

(e) Handwashing provisions satisfactory for removing glass fibers from the skin shall be provided and good personal hygiene shall be enforced. Hands, arms, and face shall be thoroughly washed prior to eating and at the end of the shift. Washing facilities shall be in in conformance with 29 CFR 1910.141(d).

(f) No food shall be stored, prepared, dispensed (even from vending machines), or eaten in fibrous glass work areas. The employer shall furnish an uncontaminated area for these purposes in conformance with 29 CFR 1910.141(g).

(g) General Housekeeping

(1) Fibrous glass waste and scrap shall be collected and

disposed of in a manner which will minimize its dispersal into the atmosphere.

(2) Emphasis shall be placed on covering waste containers, proper storage of materials, and collection of fibrous glass dust.

(3) Cleanup of fibrous glass dust shall be performed using vacuum cleaners or wet cleaning methods. Dry sweeping shall not be performed.

Section 8 - Environmental Monitoring and Recordkeeping

(a) Determination of Workplace Air Levels

Each employer, who has a place of employment in which there is occupational exposure to fibrous glass, shall determine by an industrial hygiene survey whether exposure may occur to airborne concentrations of fibrous glass above the action level, ie, above half the TWA environmental limit. Surveys shall be repeated at least once every 3 years and within 30 days of any process change likely to result in an increase of airborne fibrous glass concentrations. Records of these surveys, including the basis for concluding that air levels are at or below the action level, shall be maintained. If it has been decided that the environmental concentration of fibrous glass may exceed the action level, then the following requirements shall apply.

(b) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or permit calculation of, the exposures of all employees occupationally exposed to fibrous glass above the action level. Point source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of exposure in the breathing zone of the employee shall be collected. Procedures for sampling, calibration of equipment, and analysis of fibrous glass in samples shall be as provided in Section 1(b). This sampling and analysis shall be conducted every 3 months on at least 25% of the workers so that each worker's exposure is measured at least every year; the frequency of sampling and the fraction of employees sampled may be different if so directed by a professional industrial hygienist.

(3) For each TWA determination, a sufficient number of samples shall be taken to characterize the employee's exposure during each workshift. Variations in work and production schedules shall be considered in deciding when samples are to be collected. The number of representative TWA determinations for an operation or process shall be based on the variations in locations and job functions of employees relative to that operation or process.

(4) If an employee is found to be exposed in excess of the recommended TWA environmental limit, additional monitoring shall be promptly initiated. If excessive exposure is confirmed, control procedures shall be instituted as soon as possible; these may precede and obviate confirmatory monitoring if the employer desires. The employee shall be notified of the exposure and of the control measures being implemented. The exposure of that employee shall be measured at least once every 30 days. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, confirm that the employee's exposure no longer exceeds the recommended environmental limit. Normal monitoring may then be resumed.

(c) Recordkeeping

Records of environmental monitoring shall be maintained for each employee for at least 30 years after the individual's employment has ended. These records shall include: the dates of environmental measurements, job function and location of the employee within the worksite at time of sampling, sampling and analytical methods used, and evidence of their accuracy, number, duration, and results of samples taken, TWA determinations based on these samples, type of personal protective equipment in use, if any, name of the employee being monitored, dates of employment with the company, and information regarding changes in job assignment. Employees and former employees shall be able to obtain information on their own environmental exposures. Environmental records shall be made available to designated representatives of the Secretary of Labor and of the Secretary of Health, Education, and Welfare.

Pertinent medical records shall be retained for 30 years after the last occupational exposure to fibrous glass. Records of environmental exposures applicable to an employee should be included in that employee's medical records. These medical records shall be made available to the designated medical representatives of the Secretary of Labor; of the Secretary of Health, Education, and Welfare; of the employer; and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing impairment of health from occupational exposure to fibrous glass. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, has formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. It should be pointed out that any recommended criteria for a standard should guide management and labor to develop better engineering controls and more healthful work practices. Mere compliance with the recommended standard should not be the final goal.

These criteria for a standard for occupational exposure to fibrous glass are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of fibrous glass products as applicable under the Occupational Safety and Health Act of 1970. The proposed standard was not designed for the population-at-large, and any extrapolation beyond occupational exposure is not warranted. It is intended to (1) protect workers against development

of deleterious effects, (2) be measurable by techniques that are valid and available to industry and governmental agencies, and (3) be attainable with existing technology. The recommended standard has been designed to protect workers against the development of acute and chronic effects of exposure to fibrous glass. The acute effects include skin, eye, and respiratory tract irritation. The standard is also based on preventing chronic effects such as bronchiolar impairment, fibrosis, and carcinogenesis.

Fibrous glass first came into commercial use slightly more than 40 years ago. In one generation this material has become one of the most useful manufactured products, with tens of thousands of applications. The term fibrous glass describes a set of materials that can have different dimensions and consequently different biologic effects. Even though observed adverse effects of fibrous glass on humans have been confined primarily to skin irritation due to mechanical action, concern over possible long-term injury arising from inhaled fibers was evident from the earliest use of fibrous glass. Despite limited evidence of chronic effects from inhalation of fibrous glass, this concern continues to prevail, particularly with respect to possible long-term adverse effects in humans from exposure to fibers less than 3.5 μm in diameter over long periods of time. However, an evaluation of the available information has resulted in the NIOSH conclusion that occupational exposure to fibrous glass has not resulted in the development of cancer. No cases of human cancer that can be directly linked to exposure to fibrous glass exposure have been found. Many gaps are present in the literature on effects of fibrous glass on humans and animals. Few relevant animal experiments have been performed.

The counting method for determining the concentration of airborne fibrous glass is subject to limitations in precision and accuracy. The accuracy of the fiber counting method has not been determined and probably cannot be achieved since it provides essentially an appraised average as the final result. There are at present no other analytical techniques with which it can be adequately compared. An estimate of the accuracy of the counting procedure may be approximated empirically by comparing the results of replicate samples obtained by several proficient analytical laboratories.