U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-135-138

KAISER PERMANENTE CEMENT COMPANY
LUCERNE VALLEY, CALIFORNIA 92356
MAY 1974

I. TOXICITY DETERMINATION

It has been determined that free silica (quartz) and iron oxide dust were not toxic at the concentrations measured at the Kaiser Permanente Cement Company on January 29, 1974. This determination is based upon environmental measurements in the work place, analysis of work practices, employee interviews, and on available literature regarding the toxicities of these substances. Levels of free silica, and iron oxide were found to be below levels believed to be toxic to employees.

The potential toxicity of asbestos in very low concentrations is not known at present. Asbestos is a known carcinogen. Though air concentrations of asbestos were below present Federal Standards on a time-weighted average basis, workers should be protected from unnecessary exposure.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) Kaiser Permanente Cement Co., Lucerne Valley, California
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region IX
d) NIOSH - Region IX

For the purposes of informing the affected employees the employer will promptly "post" the Determination Report in a prominent place(s) near where exposed employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposure to materials mentioned previously at the Kaiser Permanente Cement Company, Lucerne Valley, California.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

The Kaiser Permanente Cement Company at Lucerne Valley, California is engaged in the quarrying of high grade limestone and manufacture of Portland Cement under the trade name of "Permanente". A safety inspection was performed on August 6, 1973 by the State of California Bureau of Mines Inspector. This inspection terminated at the point where the raw slurry entered the kiln. It was felt this set a jurisdictional precedent between NIOSH and the Bureau of Mines authority at this plant for this survey. Therefore, the hazard evaluation survey was started at the kiln.

B. Worksite Evaluation

A preliminary survey was conducted by NIOSH investigators on September 20, 1974 to determine potential health hazards in the work environment. The bagging of cement containing asbestos was not in operation during the preliminary survey and it was necessary to conduct a survey when this process was in operation.* On January 29, 1974, NIOSH investigators conducted a follow-up survey to determine exposure levels to asbestos dust, free silica, and iron oxide. While determining sampling locations on January 28th it was noted that a pipe used to transfer flue dust from the silo to the storage area was leaking causing this dust to contaminate the work environment. The leak had been repaired before our sampling on January 29th and the visible dust was much less in the work environment. We were informed that the flue dust is very corrosive to the transfer pipes which presents a maintenance problem. Leaking pipes should be quickly repaired to prevent unnecessary exposure of the workmen to flue dusts or other materials.

It was mentioned that asbestos is used in the Kaiser's Permanente Plastic Gun Cement. Four people are involved in the loading, blending, and bagging of the cement in a building referred to as the Packing Area. Only one person comes in contact with the asbestos. All personnel in the Packing Area during the mixing of asbestos containing cement are potentially exposed to the airborne fibers. However, the blender operator is the only one working with the "pure" asbestos.

*This is an infrequent operation which only operates about 2-4 hours per day once or twice a week

Only the bagging operation in the Packing Area was visibly dusty during the preliminary and follow-up surveys. During the preliminary survey torn bags of asbestos were noticed in the storage area. At present all bags which are removed at one time by a fork-lift truck are wrapped in a plastic material to prevent scattering the dust if one bag should break, which should help reduce exposure to asbestos dust in the storage area. The bagger and blender operators wear 3M dust masks (TC-21P-132). Coveralls are provided persons working with materials containing asbestos. The empty asbestos bags are put into a plastic bag and disposed of by sanitary landfill. The asbestos plastic gun cement is only blended usually about once or twice a week for a 2-4 hour duration.

On January 29, 1974 samples were collected to evaluate exposure in the Mill Building to free silica and iron oxide dust and in the Packing Area to asbestos dust. Both personal and area samples were collected.

C. Evaluation Methods

1. Evaluation of Environmental Dust Exposures

Bulk samples were collected during the preliminary survey and analyzed for free silica. A flue dust sample was also analyzed for iron, chromium and molybdenum. (See Table 1) The company provided a typical flue dust analysis (Table 1A). Breathing zone samples were obtained during the follow-up survey using personal monitoring equipment, some area samples were also obtained.

2. Employee Interviews

Fourteen non-directed interviews were given. Two of those interviewed complained of burns from the cottrell dust. There were general complaints about iron flue dust from the mill workers.

D. Evaluation Criteria

1. Federal Standards

The Occupational Health Standards promulgated by the U.S. Department of Labor applicable to the particular substances of this evaluation are listed below:

a. Asbestos

The Standard for asbestos as listed in the Federal Register, Volume 37, Section 1910.93(a), June 7, 1972 is outlined as follows:[1]

(1) Standard effective July 7, 1972....5.0 fibers per cc*
(2) Standards to go into effect July 1, 1976....2.0 fibers per cc*
(3) Ceiling concentrations applicable at all times....10.0 fibers per cc**

*8-hour time-weighted average airborne concentration of asbestos fibers longer than 5 microns in length per cubic centimeter (cc) of air.

**Airborne concentration of asbestos fibers longer than 5 microns in length per cc of air, not to be exceeded at any time as determined by a minimum sampling time of 15 minutes.

b. Quartz (free silica), and Inert or Nuisance Dusts

The Occupational Health Standards are promulgated by the Department of Labor (Federal Register, Part II, Section 1910.93, Tables G-1,2, and 3) applicable to substances of this evaluation are as follows:[1]

SUBSTANCE	STANDARD CONCENTRATION (8 hour time-weighted average)	
Inert or nuisance dusts	Respirable fraction	5 mg/M^3*
	Total dust	15 mg/M^3
Quartz (free SiO_2)	Respirable	$\frac{10mg/M^3}{\%SiO_2 + 2}$
	Total dust	$\frac{30mg/M^3}{\%SiO_2 + 3}$

*milligrams of substance per cubic meter of air

2. Toxic Effects

a. Asbestos

An excellent review of the literature on the use of asbestos, its hazards, and proposed standards for usage is found in the NIOSH Criteria for a Recommended Standard - Occupational Exposure to Asbestos.[2]

Prolonged inhalation of asbestos fibers may result in the production of a typical pulmonary fibrosis which may be accompanied by severe respiratory disability. If large quantities of the fibers are inhaled over an extended period of time, characteristically 10 to 20 years, tissue reaction progresses until a generalized diffuse fibrosis (known as asbestosis) becomes evident. This fibrosis is seen first in the lower lobes of the lungs but eventually, if exposure continues, appears in the other lobes as well. Respiratory insufficiency and cardiac failure may supervene. Additionally, there is increasing evidence that the frequency of bronchogenic cancer is greater among workers in certain asbestos industries than expected in the general male population as well as more evidence of an increased rate of occurrence of mesothelioma of the pleura or peritoneum. These asbestos associated neoplasms may occur without radiological evidence of asbestosis which means that prevention of even short-term high level exposures to asbestos may be extremely important.

b. Nuisance Dust (iron oxide)

Iron and iron compounds have not been shown by industrial experience to be particularly toxic. Mottling of the lungs due to inhalation of particulate iron (siderosis) is now regarded as a benign pneumoconiosis,[3] producing little or no disability from years exposure but may present problems in diagnosing other more serious lung conditions masked by the iron particles. Siderosis has not progressed to fibrosis and generally requires six to ten years of exposure to iron oxide fume in order to produce it.[4] Iron oxide dust is considered a nuisance dust and thus has a standard of 15 mg/M^3 (total particulates) or 5 mg/M^3 respirable dust. As a fume 10 mg/M^3 has been established as a standard.

Though "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect on exposure kept under reasonable control. Excessive concentrations of such dust in the workroom air may seriously reduce visibility (iron oxide), may cause unpleasant deposit in the eyes, ears, and nasal passages (Portland Cement dust), or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedure necessary for their removal.[4]

c. Free Silica (SiO_2)

Finely divided silica in the free state can cause an illness called silicosis. Silicosis may be recognized either as an acute or chronic process. The acute form (rapidly developing silicosis) may be recognized after 8 to 18 months from first exposure and probably develops after massive exposure. Patients note severe shortness of breath and rapid breathing and chest X-rays often show fibrosis with no visible typical nodulation of silicosis. Tuberculosis is often present. Chronic pulmonary silicosis is a type most often seen in industry, and usually occurs only after years (sometimes 15 to 30) of exposure to silica dust. A chest X-ray will usually detect silicosis in a relatively early stage. However, an uncomplicated case may progress to an advanced stage while showing only symptoms of moderate shortness of breath.[5]

A chest X-ray, together with a case history are basic in making a diagnosis of an early case of silicosis, since the early stages of the disease may be asymptomatic. The chest X-ray is not diagnostic, and needs to be supported by other clinical findings to rule out other diseases.[3]

Prevention is extremely important since treatment is not effective for the pulmonary lesions. Insuring that levels for free silica are below the Federal Standards is the best preventive measure.

E. Evaluation Results

1. Air Sampling

a. Asbestos

Asbestos concentrations reported as fibers per cc are reported in Table 2. The asbestos dust counts do not exceed the present Standard of 5 fibers per cc. However, better controls need to be provided to meet the 2 fibers per cc Standard to go into effect in 1976. The blending machine might be partially enclosed to increase the efficiency of the exhaust system. The bagging machine operation was visibly dusty and should be provided better dust control equipment.

Since asbestos is a carcinogen. All unnecessary exposure to asbestos must be avoided.

b. Flue Dust (iron oxide)

The main constituent of the flue dust is iron oxide. The air concentrations determined for this material are shown in Table 3. These dust levels are below the present U.S. Department of Labor Standard for nuisance dust. At these concentrations the dust should be relatively innocuous but as has been pointed out previously may cause injury to the skin or mucous membranes by chemical or mechanical action or by the rigorous skin cleansing procedure necessary for their removal. It is recognized that workers sometimes are required to work in dusty operations for relatively short periods of time. Dust respirators should be worn during these work periods to prevent unnecessary exposure of the respiratory tract to the dusty materials.

c. Free Silica

Air concentration levels of free silica are reported in Table 4. The levels determined during the survey period were below present U.S. Department of Labor Standards for free silica. Each respirable dust sample was collected simultaneously with a total dust sample for comparison purposes. Free silica was the controlling factor in calculating the acceptable level for the dust involved since acceptable concentrations would be higher, (i.e., would be the nuisance level) if silica were not present. Silica dust levels were found to be at acceptable levels according to present Health Hazard Evaluation Criteria.

The silica feed and red bone settled dust contained relatively high percentages of free silica. Dust in these areas should be well controlled by engineering methods at all times to maintain air concentrations of free silica below acceptable standards.

V. RECOMMENDATIONS

To reduce employee exposure to the various particulate matter used at the Kaiser Permanente Cement Plant at Lucerne Valley the following recommendations are made:

A. Mill Area

1. Personnel should wear respiratory protective devices for short exposures to high concentrations of dust. The best protective device is one that is worn. Where respirators are used they should be properly fitted and maintained and employees should be instructed in the correct use of the respirators.

2. Leaks in transfer pipes should be quickly repaired to reduce exposure of workers to particulate matter.

3. Present heavy dust accumulations in the plant should be removed to prevent this material from being blown around on windy days and better housekeeping procedures instituted.

4. Air contamination from dusty operations shall be controlled by engineering methods where possible.

B. All Areas Where Asbestos Is Present

1. Section 1910.93(a) (asbestos) of the Federal Register, Volume 37, October 18, 1972 has detailed requirements for working with asbestos, this includes such things as labeling, special clothing when the ceiling levels are exceeded, respirators, medical examinations, environmental monitoring, etc. A copy of these rules and regulations pertaining to persons working with asbestos is provided in the Appendix of this report.

2. Improved local exhaust ventilation for the bagging and blending operation should be provided.

3. A vacuum cleaner has been provided for cleaning areas where asbestos dust may accumulate. The vacuum cleaner should be used after each job is completed to prevent accumulation of asbestos dust.

4. Protective clothing used during work with asbestos materials should be laundered at the plant to prevent possible contamination of the workers home with asbestos fibers.

5. Respirators should be worn in all areas where potential exposure to asbestos dust may occur as specified in U.S. Department of Labor Regulations.

C. Cottrells

1. Personnel working in the cottrells should be provided protective equipment and clothing to prevent skin burns while working in the cottrells.

D. General

1. The company has started a medical monitoring program for detecting asbestosis and silicosis. Medical surveillance of workers exposed to asbestos and silica includes periodic physical examinations, chest X-rays, and pulmonary function testing. A complete discussion of recommended surveillance for asbestos (which will be adequate for silica exposure) appears in the NIOSH Criteria Document for a Recommended Standard for Asbestos. (See Reference 2)

VI. REFERENCES

1. Federal Register: Wednesday, October 18, 1972.

2. U.S. Department of Health, Education and Welfare: Criteria for a recommended standard...Occupational Exposure to Asbestos, (1972).

3. Occupational Health and Safety: Volume II, International Labour Office, Geneva, Mac Graw Hill, New York, (1971)

4. American Conference of Governmental Industrial Hygienists: Documentation of Threshold Limit Values, Third Edition, 1971.

5. Occupational Diseases - A Guide to their Recognition: W.M. Gafafer, editor, USDHEW, PHS, Publication No. 1097, 1964.

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Acknowledgments

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TABLE 1 - ANALYSIS OF BULK SAMPLES FOR FREE SILICA AND IRON

Material	% SiO_2	% Fe
Clinker Dust	0.0	1.7
Clinker Dust Baghouse	0.08	1.7
Settled Dust Tripper Floor	1.4	2.0
Settled Dust at Silica Feed	9.5	4.3
Red Bone	8.7	4.0
Flue Dust*	1.2	15.5
Asbestos Gun Cement	<1.0	--

*NOTE: Chromium compounds in cement may cause dermatitis. Therefore, the flue dust was analyzed for chromium and molybdenum. The flue dust contained 0.07% chromium and 0.002% molybdenum which are negligible amounts.

TABLE 1A - A TYPICAL FLUE DUST ANALYSIS*

Material	Percentage
Fe_2O_3	57.8
SiO_2	2.3
Al_2O_3	2.6
CaO	11.0
MgO	2.2
Zn	<1.0

*This analysis was provided by Curtis Jenkins, Supervisory Spectroscopist for Kaiser Cement.

TABLE 2 - ASBESTOS IN AIR CONCENTRATIONS

Location	Sampling Period	Asbestos concentration fibers/cc	Present TLV
Blender operator (personal sample)	7:14-8:10AM 1-29-74	5.6	5.0
	8:10-10:54*	2.7	5.0
	7:14-9:33*	4.3	5.0
	9:33-10:54 and 11:35-1:10PM	1.5	5.0
Sack Loader (personal sample)	7:06-9:35* 1-29-74	1.4	5.0
	9:35-10:59	2.8	5.0
Packer Operator (personal sample)	7:12-10:47* 1-29-74	Unable to count	-
	7:12-9:37*	2.3	5.0
	9:37-10:35	2.1	5.0
Area Samples colleected at 10&pm at the bagging machine			
	1 minute sample	3.4	5.0
	2 " "	1.9	5.0
	5** " "	0.6	5.0
	3 " "	2.8	5.0

*Minus 23 minutes.

**Operator was at the bagging machine during all of the sampling period, but was not actually bagging during all of the sampling period.

NOTE: The TLV is based on an 8 hour time weighted average concentration, the asbestos exposure in the packing area is only for short intermittent periods of time. The ceiling concentration of 10 fibers/cc applicable at all times was not exceeded during the survey.

TABLE 3 - Fe_2O_3 IN AIR CONCENTRATIONS IN THE MILL BUILDING

1-29-74

Location	Fe_2O_3 mg/M^3
Personal Sample - Miller	0.4
" " - Ass't Mill Helper	0.2
Rear of operators booth, Mill Building	<0.2
Near Salt Dispenser, Mill Building	<0.2
Personal Sample - Mill Helper	0.5
" " - Clinker Cooler Tender	0.2
" " - Bagging Machine Operator	<0.2
" " - Mill Bin Tender	<0.2

TABLE 4 - FREE SILICA IN AIR CONCENTRATIONS

Location	Respirable Dust Concentration mg/M^3	Respirable Dust TLV mg/M^3	Total Dust Concentration mg/M^3
Cooler Tender	0.3	1.25	5.5
Mill-Bin Tender (Tripper Floor)	0.3	1.25	4.7
Miller	0.6	1.25	6.5
Mill Helper	0.8	1.25	8.2
Ass't Mill Helper	1.1	1.25	5.5
Area Sample Tripper Deck	0.5	--	4.8
Area Sampler Cooler Basement Middle of B Belt	0.5	--	--
Sack Loader	-	*	8.6
Asbestos Cement Bagging Machine:			
Back of Operator	0.4	*	5.8
Left of Operator	0.3	*	--
Right of Operator	0.1	*	--

Where dust contains more than 1% free silica the respirable free silica standard applies rather than the nuisance dust criteria. In order to get enough material for an accurate analysis the personal samples obtained from 5 workers in the mill were combined, the resulting free silica value of 6.0% was used in determining the TLV for free silica. The 6.0% free silica value may be high for some areas, but should be a representative average of the mill area since the silica feed and red bone contains greater than 6.0% free silica.

*Since the cement contains asbestos the asbestos TLV applies.

APPENDIX

HEALTH HAZARD EVALUATION 73-135

KAISER CEMENT COMPANY

LUCERNE VALLEY, CALIFORNIA

§ 1910.93a Asbestos.

(a) *Definitions.* For the purpose of this section, (1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.

(b) *Permissible exposure to airborne concentrations of asbestos fibers*—(1) *Standard effective July 7, 1972.* The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(2) *Standard effective July 1, 1976.* The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed two fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(3) *Ceiling concentration.* No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(c) *Methods of compliance*—(1) *Engineering methods.* (i) *Engineering controls.* Engineering controls, such as, but not limited to, isolation, enclosure, exhaust ventilation, and dust collection, shall be used to meet the exposure limits prescribed in paragraph (b) of this section.

(ii) *Local exhaust ventilation.* (a) Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2–1971, which is incorporated by reference herein.

(b) See § 1910.6 concerning the availability of ANSI Z9.2–1971, and the maintenance of a historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(iii) *Particular tools.* All hand-operated and power-operated tools which may produce or release asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems in accordance with subdivision (ii) of this subparagraph.

(2) *Work practices*—(i) *Wet methods.* Insofar as practicable, asbestos shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers in excess of the exposure limits prescribed in paragraph (b) of this section, unless the usefulness of the product would be diminished thereby.

(ii) *Particular products and operations.* No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne asbestos fibers in excess of the limits prescribed in paragraph (b) of this section.

(iii) *Spraying, demolition, or removal.* Employees engaged in the spraying of asbestos, the removal, or demolition of pipes, structures, or equipment covered or insulated with asbestos, and in the removal or demolition of asbestos insulation or coverings shall be provided with respiratory equipment in accordance with paragraph (d)(2)(iii) of this section and with special clothing in accordance with paragraph (d)(3) of this section.

(d) *Personal protective equipment*—(1) Compliance with the exposure limits prescribed by paragraph (b) of this section may not be achieved by the use of respirators or shift rotation of employees, except:

(i) During the time period necessary to install the engineering controls and to institute the work practices required by paragraph (c) of this section;

(ii) In work situations in which the methods prescribed in paragraph (c) of this section are either technically not feasible or feasible to an extent insufficient to reduce the airborne concentrations of asbestos fibers below the limits prescribed by paragraph (b) of this section; or

(iii) In emergencies.

(iv) Where both respirators and personnel rotation are allowed by subdivisions (i), (ii), or (iii) of this subparagraph, and both are practicable, personnel rotation shall be preferred and used.

(2) Where a respirator is permitted by subparagraph (1) of this paragraph, it shall be selected from among those approved by the Bureau of Mines, Department of the Interior, or the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare, under the provisions of 30 CFR Part 11 (37 F.R. 6244, Mar. 25, 1972), and shall be used in accordance with subdivisions (i), (ii), (iii), and (iv) of this subparagraph.

(i) *Air purifying respirators.* A reusable or single use air purifying respirator, or a respirator described in subdivision (ii) or (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed no more than 10 times those limits.

(ii) *Powered air purifying respirators.* A full facepiece powered air purifying respirator, or a powered air purifying respirator, or a respirator described in subdivision (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average concentrations of asbestos fibers are reasonably expected to exceed 10 times, but not 100 times, those limits.

(iii) *Type "C" supplied-air respirators, continuous flow or pressure-demand class.* A type "C" continuous flow or pressure-demand, supplied-air respirator shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed 100 times those limits.

(iv) *Establishment of a respirator program.* (a) The employer shall establish a respirator program in accordance with the requirements of the American National Standards Practices for Respiratory Protection, ANSI Z88.2–1969, which is incorporated by reference herein.

b. See § 1910.6 concerning the availability of ANSI Z88.2–1969 and the maintenance of an historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(c) No employee shall be assigned to tasks requiring the use of respirators if, based upon his most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or other employees will be impaired by his use of a respirator. Such employee shall be rotated to another job or given the opportunity to transfer to a different position whose duties he is able to perform with the same employer, in the same geographical area and with the same seniority, status, and rate of pay he had just prior to such transfer, if such a different position is available.

(3) Special clothing: The employer shall provide, and require the use of, special clothing, such as coveralls or similar whole body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos fibers, which exceed the ceiling level prescribed in paragraph (b) of this section.

(4) Change rooms: (i) At any fixed place of employment exposed to airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, the employer shall provide change rooms for employees working regularly at the place.

(ii) Clothes lockers: The employer shall provide two separate lockers or containers for each employee, so separated or isolated as to prevent contamination of the employee's street clothes from his work clothes.

...) Laundering: (a) Laundering of ... contaminated clothing shall be ... to prevent the release of air... asbestos fibers in excess of the ex... prescribed in paragraph (b) ... section.

... employer who gives asbestos... clothing to another person ... shall inform such person ... requirement in (a) of this subdi... to effectively prevent the release ... asbestos fibers in excess of ... limits prescribed in para... of this section.

... clothing shall be ... sealed impermeable bags, ... impermeable containers, ... in accordance with para... of this section.

... *Method of measurement.* All de... of airborne concentrations ... fibers shall be made by the ... filter method at 400–450 × ... (4 millimeter objective) ... contrast illumination.

... *Monitoring*—(1) *Initial determi...* Within 6 months of the publi... of this section, every employer ... cause every place of employment ... asbestos fibers are released to be monitored in such a way as to determine ... every employee's exposure to ... fibers is below the limits pre... in paragraph (b) of this sec... If the limits are exceeded, the em... shall immediately undertake a ... program in accordance with ... (c) of this section.

(2) *Personal monitoring*—(i) Samples shall be collected from within the breathing zone of the employees, on membrane filters of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) Sampling frequency and patterns. After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of employees. In no case shall the sampling be done at intervals greater than 6 months for employees whose exposure to asbestos may reasonably be foreseen to exceed the limits prescribed by paragraph (b) of this section.

(3) *Environmental monitoring*—(i) ... samples shall be collected from areas of ... work environment which are represent... of the airborne concentrations of ... asbestos fibers which may reach the ... breathing zone of employees. Samples ... be collected on a membrane filter ... 0.8 micrometer porosity mounted in ... open-face filter holder. Samples shall ... taken for the determination of the 8-... time-weighted average airborne ... concentrations and of the ceiling con... tions of asbestos fibers.

... *Sampling frequency and patterns.* ... the initial determinations required ... subparagraph (1) of this paragraph, ... samples shall be of such frequency and ... pattern as to represent with reasonable ... accuracy the levels of exposure of the ... employees. In no case shall sampling be at intervals greater than 6 months for employees whose exposures to asbestos may reasonably be foreseen to exceed the exposure limits prescribed in paragraph (b) of this section.

(4) *Employee observation of monitoring.* Affected employees, or their representatives, shall be given a reasonable opportunity to observe any monitoring required by this paragraph and shall have access to the records thereof.

(g) *Caution signs and labels.* (1) *Caution signs.* (i) *Posting.* Caution signs shall be provided and displayed at each location where airborne concentrations of asbestos fibers may be in excess of the exposure limits prescribed in paragraph (b) of this section. Signs shall be posted at such a distance from such a location so that an employee may read the signs and take necessary protective steps before entering the area marked by the signs. Signs shall be posted at all approaches to areas containing excessive concentrations of airborne asbestos fibers.

(ii) *Sign specifications.* The warning signs required by subdivision (i) of this subparagraph shall conform to the requirements of 20" x 14" vertical format signs specified in § 1910.145(d)(4), and to this subdivision. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to that specified in this subdivision.

Legend	*Notation*
Asbestos	1" Sans Serif, Gothic or Block.
Dust Hazard	¾" Sans Serif, Gothic or Block.
Avoid Breathing Dust	¼" Gothic.
Wear Assigned Protective Equipment.	¼" Gothic.
Do Not Remain In Area Unless Your Work Requires It.	¼" Gothic.
Breathing Asbestos Dust May Be Hazardous To Your Health.	14 point Gothic.

Spacing between lines shall be at least equal to the height of the upper of any two lines.

(2) *Caution labels*—(i) *Labeling.* Caution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section will be released.

(ii) *Label specifications.* The caution labels required by subdivision (i) of this subparagraph shall be printed in letters of sufficient size and contrast as to be readily visible and legible. The label shall state:

CAUTION

Contains Asbestos Fibers

Avoid Creating Dust

Breathing Asbestos Dust May Cause Serious Bodily Harm

(h) *Housekeeping*—(1) *Cleaning.* All external surfaces in any place of employment shall be maintained free of accumulations of asbestos fibers if, with their dispersion, there would be an excessive concentration.

(2) *Waste disposal.* Asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing, consigned for disposal, which may produce in any reasonably foreseeable use, handling, storage, processing, disposal, or transportation airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(i) *Recordkeeping*—(1) *Exposure records.* Every employer shall maintain records of any personal or environmental monitoring required by this section. Records shall be maintained for a period of at least 3 years and shall be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health, and to authorized representatives of either.

(2) *Employee access.* Every employee and former employee shall have reasonable access to any record required to be maintained by subparagraph (1) of this paragraph, which indicates the employee's own exposure to asbestos fibers.

(3) *Employee notification.* Any employee found to have been exposed at any time to airborne concentrations of asbestos fibers in excess of the limits prescribed in paragraph (b) of this section shall be notified in writing of the exposure as soon as practicable but not later than 5 days of the finding. The employee shall also be timely notified of the corrective action being taken.

(j) *Medical examinations*—(1) *General.* The employer shall provide or make available at his cost, medical examinations relative to exposure to asbestos required by this paragraph.

(2) *Preplacement.* The employer shall provide or make available to each of his employees, within 30 calendar days following his first employment in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination, which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

(3) *Annual examinations.* On or before January 31, 1973, and at least annually thereafter, every employer shall provide, or make available, comprehensive medical examinations to each of his employees engaged in occupations exposed to airborne concentrations of asbestos fibers. Such annual examination shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

(4) *Termination of employment.* The employer shall provide, or make available, within 30 calendar days before or after the termination of employment of any employee engaged in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$).

(5) *Recent examinations.* No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with this paragraph within the past 1-year period.

(6) *Medical records*—(i) *Maintenance.* Employers of employees examined pursuant to this paragraph shall cause to be maintained complete and accurate records of all such medical examinations. Records shall be retained by employers for at least 20 years.

(ii) *Access.* The contents of the records of the medical examinations required by this paragraph shall be made available, for inspection and copying, to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of NIOSH, to authorized physicians and medical consultants of either of them, and, upon the request of an employee or former employee, to his physician. Any physician who conducts a medical examination required by this paragraph shall furnish to the employer of the examined employee all the information specifically required by this paragraph, and any other medical information related to occupational exposure to asbestos fibers.