The Medical Surveillance of Persons Exposed to Asbestos

Asbestosis, lung cancer and diffuse malignant mesothelioma of the pleura or peritoneum are the three major asbestos-related diseases which are associated with occupational exposure to asbestos. Less clear-cut associations have been documented for gastro-intestinal tract cancers, laryngeal cancers and non-Hodgkins lymphoma of the gastro-intestinal tract. It has been postulated that renal cancer and pancreatic cancer may be more prevalent among asbestos exposed populations but this association lacks epidemiologic verification. Asbestos exposed persons who smoke cigarettes have at least a 50 times greater chance of dying from lung cancer than non-smoking non-asbestos exposed persons.

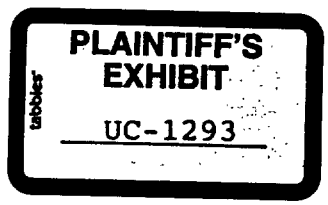
Because of its increased and widespread use in the USA in many sectors of industry during the past 50 years and lasting up until very recent times, it has been estimated that millions of people have been exposed in various ways to the different commercial forms of asbestos. Most of these workers have experienced low levels of exposure in comparison to asbestos miners and millers, asbestos textile workers, asbestos cement workers and employees of the friction materials industry. Pleural plaques without evidence of other stigmata of asbestos exposure clinically, physiologically or radiographically, are probably an important index to these low level exposures.

Medical surveillance of asbestos workers attempts to provide a tool for the detection of the earliest and least harmful effects of exposure at a stage when cessation of such exposure may be of benefit to their continued health and well-being. The asbestos-related diseases are not readily amenable to therapy. The course of asbestosis is steadily progressive, the outlook for the person with lung cancer is very poor and diffuse malignant mesothelioma of the pleura or peritoneum is invariably fatal within a short period of time after diagnosis.

The pre-placement medical evaluation is designed to determine the candidates suitability for the job and must also consider the suitability of the job for the individual concerned. This means that the physician must be completely familiar with the properties of the variety of asbestos in use, must understand the manufacturing processes in the plant and have a clear concept of the plant design and layout. Armed with this knowledge decisions can be made about prospective employees when contra-indications to asbestos exposure are present. Certain broadly defined conditions are regarded as contraindications to work with a potential for asbestos exposure. These include:

- a history of previous work in another industry with a recognized dust hazard such as coal mining or stone quarrying;

- an existing pulmonary impairment due to pneumoconiosis or other respiratory disease;



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- chronic obstructive pulmonary disorders;

- organic heart disease.

Some more specific contraindications are:

- nasal obstruction or deformity of such a degree as to make the wearing of respiratory protection devices impossible;

- gross physical deformity of the chest such as scoliosis or kyphosis;

- chronic bronchitis, bronchiectasis or emphysema;

- gross hypertension with cardiac impairment;

- the presence of rheumatoid arthritis.

The pre-placement evaluation serves the purpose of establishing base-line data which will be useful in observing the exposed persons throughout their lifetime, noting changes in measured parameters, and providing data for epidemiologic studies.

The pre-placement evaluation affords the examining physician with an opportunity to counsel and advise the job applicant regarding the known facts about the effects of asbestos exposure. It is essential to emphasize the special risks the worker runs if he or she smokes cigarettes. This habit should be strongly discouraged.

Persons exposed to asbestos should be kept under medical surveillance. The object of periodic examinations is to detect early changes in the worker's physiologic status, radiologic appearances and work capacity. The findings are recorded systematically on an on-going basis to allow comparison from one evaluation to the next.

OSHA requires that every employer shall provide, or make available, at least annually, comprehensive medical examinations to each employee engaged in an occupation exposed to airborne concentrations of asbestos fibers. The minimum requirement is for

"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 ($FEV_{1.0}$)."

Early effects of exposure may be discovered as the result of periodic medical surveillance examinations. They may occur at a stage when removal from further occupational exposure to asbestos could possibly arrest or significantly delay the progress of asbestosis, or the occurrence of other asbestos-related conditions.

Table 1 lists the minimum requirements of a satisfactory medical surveillance program for asbestos exposed persons. It is generally agreed

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that OSHA's present requirement for annual examinations may not be necessary in the light of present conditions in industry. When the current asbestos standard is revised, it is expected that the frequency and periodicity of the components listed in Table 1 will change. Table 2 is based upon the recommendations for medical surveillance presented by Dr. Hilton C. Lewinsohn at the hearings on the OSHA proposal to revise the Asbestos Standard.

The scheme outlined in Table 2 retains an annual medical history questionnaire but varies the periodicity of x-rays, lung function tests and physical examinations. The chest x-ray is not repeated until 5 years after the pre-placement examination or until the employee reaches age 35 years, whichever occurs first. Pulmonary function tests and physical examination have the same periodicity. Between ages 36 and 45 years or 5-10 years exposure, whichever occurs first, the periodicity of chest x-rays, lung funtion tests and physical examinations will be every 2 years. Persons over age 45 or having had more than 10 years exposure to asbestos will be examined, x-rayed and have lung function tests annually.

The medical examiner should concentrate on eliciting the symptoms and signs of pulmonary fibrosis. The findings include progressive effort dyspnoea, finger-clubbing and bilateral end-respiratory fine crackles on auscultation of the chest. In the case of the more heavily exposed employees, in those with long service and in those who are cigarette smokers, the possibility of lung cancer must always be borne in mind.

Transient plueral effusions, often asymptomatic, can occur in asbestos workers. Pleural lesions are often the first indicator of exposure effects. Pleural plaques, with or without calcification, not usually producing any physiological impairment, may be the most frequently identified radiologic abnormality. Diffuse pleural thickening is sometimes seen and in rare cases can lead to impairment of lung function.

Radiographic lesions in the lung parenchyma are often subtle in the early stages and skilled x-ray reading techniques should be employed which are based on the ILO U/C Classification of Radiographs for the Pneumoconioses.

The earliest effects of exposure may be those detected by lung function tests. The measurement of the timed components of the vital capacity is valuable in demonstrating the development of the characteristic restriction of lung function which occurs with pulmonary fibrosis. Where facilities exist for more complete lung function studies, the single-breath carbon monoxide diffusing capacity should be done.

The value of sputum cytology in the periodic follow-up of asbestos workers has not yet been adequately quantified. Computed tomography may be of value as a diagnostic tool to differentiate pleural tumors from plaques and to detect early asbestosis. This is not a procedure which is suitable for routine periodic medical surveillance.

Persons who have been exposed to asbestos should be kept under surveillance even though exposure has ceased. The long lapsed period between

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first exposure and observation of any of the biological effects mandates careful follow-up for many years. In some cases this could lead to the early detection of lung cancer and possible life prolonging or pain relieving treatment.

The prevention of asbestos-related diseases depends on good engineering technology and dust control. The technique of medical surveillance is merely one cog in the wheel which comprises the total effort required to safeguard employee health.

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TABLE 1.

Minimum requirements to be recorded to establish a data base for long term follow-up of asbestos workers.

Complete, detailed, occupational history since leaving school

Family history

Smoking history

Social history (drugs, alcohol, etc.)

Previous illnesses of note, especially respiratory ailments

Detailed respiratory symptoms history (MRC or ATS Respiratory Symptoms Questionnaire)

Vital and physical signs

Special investigations: 17" X 14" Postero-anter chest roentgenogram*

Measurement of lung function (ventilatory capacity, lung volumes, gas transfer, etc.)

Sputum cytology (value not proven in screening)

Measurement of angle between nail and cuticle to document appearance of clubbing of fingers.

*Oblique views, and occassionally lateral views, may be required to clarify pleural abnormalities.

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TABLE 2

MEDICAL SURVEILLANCE OF PERSONS EXPOSED TO ASBESTOS: PERIODICITY OF MANDATORY PROCEDURES

TYPE OF PROCEDURE	PRE-EMPLOYMENT OR PRE-ASSIGNMENT	PERIODIC						TERMINATION	POST-EMPLOYMENT	
		AGE			EXPOSURE				RETIREES	OTHERS
		35	35-45	45	5	5-10	10			
Medical History (Respiratory Symptoms Questionnaire See Ap. B1 & B2)	Obligatory	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	Obligatory as in Preplacement Examination	**BY MAIL ONLY** Annual 1) Reminder to continue with medical checks. 2) Questionnaire	Advisory Letter at Termination - Continue Medical Checks
Physical Examination	Obligatory To include examination of Respiratory System and Digestive System	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Chest Radiology (PA view 14" x 17") See Appendices C1 & C2)	Obligatory (Not required if recent film available, i.e., within preceding 12 months)	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Pulmonary Function (FEV_1, FVC, FEV_1/FVC %) See App. D1 & D2	Obligatory	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Other e.g., Sputum Cytology	Voluntary	N/A	N/A	ANNUAL	N/A	N/A	ANNUAL	Voluntary	Voluntary	"

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(m) Medical Surveillance (1) General. (i) The employer shall institute a medical surveillance program for all employees who are exposed to airborne concentrations of asbestos fibers in excess of the action level for more than a total of 30 days per year.

(ii) The employer shall assure that all medical examinations and procedures are performed by persons under the supervision of a licensed physician. Minimal training guidelines (non-mandatory) for physicians supervising the medical surveillance of asbestos exposed persons are briefly outlined in Appendix D.

(iii) Persons other than such licensed physicians, who administer the pulmonary function testing required by this section, shall complete a training course in spirometry approved by an appropriate academic or professional institution.

(2) Preplacement. (i) The employer shall provide or make available to each exposed employee as defined in (m)(1)(i), a comprehensive medical examination prior to first employment (or reassignment for the first time from other duties in such conditions) no later than 30 days from the date of first employment (or re-assignment).

(ii) Such examination shall include, as a minimum, a questionnaire to elicit symptoms of respiratory disease (Appendix A(1)),

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pulmonary function tests of ventilatory capacity such as forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$), and a chest roentgenogram (posterior-anterior view 14 x 17 inches). Chest roentgenographic examinations shall be made in accordance with the specifications stipulated in Appendix B [(1) & (2)]. Pulmonary function tests shall be administered and interpreted in accordance with the specifications stipulated in Appendix C [(1) & (2)].

(iii) Employees with 10 or more years of prior exposure to airborne concentrations of asbestos fibers in occupations where the action level was or could have been exceeded, who are 45 years of age or older and who also smoke more than 5 cigarettes (or the equivalent amount of tobacco in other form) per 24 hour period, shall be given the opportunity to provide a sputum sample for cytologic examination by a CDC approved laboratory.

(3) Periodic examinations. (i) Every employer shall provide or make available comprehensive medical examinations to each employee who was required to have a preplacement (pre-employment of pre-assignment) examination under the provisions of this paragraph, the periodicity to be determined in accordance with the schedule in Table 1.

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MEDICAL SURVEILLANCE OF PERSONS EXPOSED TO ASBESTOS: PERIODICITY OF MANDATORY PROCEDURES

Believe some overkill here

TYPE OF PROCEDURE	PRE-EMPLOYMENT OR PRE-ASSIGNMENT	PERIODIC AGE			PERIODIC EXPOSURE			TERMINATION	POST-EMPLOYMENT RETIREES	POST-EMPLOYMENT OTHERS
		35	35-45	45	5	5-10	10		BY MAIL ONLY	
Medical History (Respiratory Symptoms Questionnaire See Ap. B1 & B2)	Obligatory	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	Obligatory as in Preplacement Examination	Annual 1) Reminder to continue with medical checks. 2) Questionnaire	Advisory Letter at Termination Continue Medical Checks
Physical Examination	Obligatory To include examination of Respiratory System and Digestive System	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Chest Radiology (PA view 14" x 17") See Appendices C1 & C2)	Obligatory (Not required if recent film available, i.e., within preceding 12 months)	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Pulmonary Function (FEV_1, FVC, FEV_1/FVC %) See App. D1 & D2	Obligatory	Every 5 Years	Every 2 Years	ANNUAL	Every 5 Years	Every 2 Years	ANNUAL	Obligatory as in Preplacement Examination	Voluntary By Own Physician	"
Other e.g., Sputum Cytology	Voluntary	N/A	N/A	ANNUAL	N/A	N/A	ANNUAL	Voluntary	Voluntary	"

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(ii) The periodic examination shall include a questionnaire to elicit symptomatology of respiratory disease, (Appendix A(2)) pulmonary function tests as in (m)(2)(ii) and a chest roentgenogram (posterior-anterior 14 x 17 inches). The frequency of each procedure shall be as required in Table 1. Chest roentgenographic examinations shall be made in accordance with the specifications stipulated in Appendix B [(1) & (2)]. Pulmonary function tests shall be administered and interpreted in accordance with the specifications stipulated in Appendix C [(1) & (2)].

(iii) Employees with 10 or more years of exposure to airborne concentrations of asbestos fibers in excess of the prescribed action level who are 45 years of age or older, and who habitually smoke more than 5 cigarettes in 24 hours (or the equivalent amount of tobacco in other form), shall be given the opportunity to provide a sample of sputum for cytologic examination by a CDC approved laboratory.

(4) Termination of employment. The employer shall provide, or make available, a comprehensive medical examination within 30 calendar days before or after the date of termination of employment of any employee who has been exposed to airborne concentrations of asbestos in excess of the

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prescribed action level for more than a total of 30 days in the preceding twelve month period. The examination shall be in accordance with and comparable to the requirements of the Periodic examinations stipulated in (m)(3)(i)-(iii).

(5) Recent examinations. No medical examination is required of any employee who has been exposed to airborne concentrations of asbestos fibers in excess of the prescribed action level for more than 30 days in the preceding twelve month period, if adequate medical records show that the employee has been examined in accordance with this section of the rules within the past one year period.

(6) Employee notification. (i) Any employee found to exhibit any of the effects which the examining physician attributes to the documented exposure of such employee to airborne concentrations of asbestos fibers in excess of the prescribed action level, shall be immediately notified in writing of the results of the medical examination. The physician's opinion will be in the format prescribed in 6(iii)(A)-(C).

(ii) Any employee who has been medically examined, and who, in the opinion of a physician qualified to interpret the results of such examination administered in accordance with the specifications in Appendices A, B & C, based upon the evaluation of the work history, respiratory symptoms and signs, pulmonary function tests and one or more

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of the employees's chest roentgenograms, exhibits significant effects of asbestos exposure, shall be afforded the option of transferring as soon as feasible from his or her position to another position in an area of the workplace, if such is available, where the concentration of respirable airborne asbestos fibers does not exceed the action level prescribed in these regulations.

(iii) With respect to each examination required by this paragraph, the employer shall obtain a written opinion from the examining physician, containing the following:

(A) The physician's opinion as to whether the examined employee has any medical conditions which would place the employee at increased risk of material impairment of his or her health from exposure to asbestos fibers, or which would, directly or indirectly, be aggravated by such exposure;

(B) Any recommended limitations upon the employee's exposure to asbestos fibers, or upon the use of protective clothing and equipment, such as respirators; and

(C) A statement that the employee has been informed by the physician of any medical conditions which require further examination or treatment.

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(iv) The written opinion shall not reveal specific findings or diagnoses unrelated to occupational exposure to asbestos fibers.

(7) Medical Records. The employer shall keep an accurate medical record for each employee subject to medical surveillance required by paragraph ( ) of this section.

(i) A record shall include:

(A) Physician's written opinion;

(B) Any employee medical complaints related to exposure to asbestos;

(C) A signed statement of any refusal to be examined, in accordance with paragraphs (3)(i)-(iii) and (4) of this section.

(ii) Each record shall be maintained for at least 40 years, or for the duration of the employee's employment plus 20 years, whichever period is longer.

(8) Access. Access to employee medical records shall be in accordance with the relevant paragraphs of CFR 29, 1910.1001 (j)(6)(iii), effective August 21, 1980, as corrected.

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APPENDIX A(1) : **INITIAL MEDICAL EXAMINATION**
PRIVATE AND CONFIDENTIAL

QUESTIONNAIRE – SELF-COMPLETION

Thank you for your willingness to participate; your cooperation is very important to the success of our medical program.

This is a questionnaire you are asked to fill out. Please answer the questions as frankly and accurately as possible. ALL INFORMATION OBTAINED IN THE STUDY WILL BE KEPT CONFIDENTIAL AND USED FOR MEDICAL PURPOSES ONLY. Your personal physician will be informed about the test results if you desire.

The questions can be answered by checking the best answer or by filling in a blank with a number or word.

Example: Do you live in the United States 1. Yes ✓
2. No. ____

If you desire help in answering a question, please put a check (✓) in *front* of the question number. You will be helped with these questions at the time of your appointment.

For Office Use

1. NAME: _____

2. SOCIAL SECURITY # ___ ___ ___ ___ ___ ___ ___ ___ ___ (1 2 3 4 5 6 7 8 9) — Card 1

3 CLOCK NUMBER ___ ___ ___ ___ ___ ___ (10 11 12 13 14 15)

4. PRESENT OCCUPATION: _____

5. PLANT: _____

6. ADDRESS: _____

7. _____ (Zip Code)

8. TELEPHONE NUMBER: _____

9. INTERVIEWER: _____

10. DATE: _____ ___ ___ ___ ___ ___ ___ (16 17 18 19 20 21)

11. Date of Birth: _____ (Month Day Year) ___ ___ ___ ___ ___ ___ (22 23 24 25 26 27 — MO DAY YR)

12. Place of Birth: _____ (28 - 31)

13. Sex: 1. Male ____ 2. Female ____ (32)

14. What is your marital status? 1. Single ____ 2. Married ____ 3. Widowed ____ 4. Separated/Divorced ____ (33)

15. Race: 1. White ____ 2. Black ____ 3. Oriental ____ 4. Other ____ (34)

16. What is the highest grade completed in school? _____ (35 - 36)
(*For example*: 12 years is completion of high school).

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For Office Use

19. CHEST COLDS AND CHEST ILLNESSES

19A. If you get a cold, does it usually go to your chest? (Usually means more than ½ the time.) — 1. Yes ____ 2. No ____ 3. Don't get colds ____ (64)

20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? — 1. Yes ____ 2. No ____ (65)

IF *YES* TO 20A:

B. Did you produce phlegm with any of these chest illnesses? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (66)

C. In the last 3 years, how many such illnesses, with (increased) phlegm, did you have which lasted a week or more? — ____ Number of illnesses ____ No such illnesses 8. Does not apply ____ (67)

21. Did you have any lung trouble before the age of 16? — 1. Yes ____ 2. No ____ (68)

22. Have you ever had any of the following?

1A. Attacks of bronchitis? — 1. Yes ____ 2. No ____ (69)

IF *YES* TO 1A:

B. Was it confirmed by a doctor? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (70)

C. At what age was your first attack? — ____ Age in years 88. Does not apply ____ (71 - 72)

2A Pneumonia (include bronchopneumonia)? — 1. Yes ____ 2. No ____ (73)

IF *YES* TO 2A:

B. Was it confirmed by a doctor? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (74)

C. At what age did you first have it? — ____ Age in years 88. Does not apply ____ (75 - 76)

3A. Hay fever? — 1. Yes ____ 2. No ____ (77)

IF *YES* TO 3A:

B. Was it confirmed by a doctor? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (78)

C. At what age did it start? — ____ Age in years 88. Does not apply ____ (79 - 80)

23A. Have you ever had chronic bronchitis? — 1. Yes ____ 2. No ____ (1) CARD 2.

IF *YES* TO 23A:

B. Do you still have it? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (2)

C. Was it confirmed by a doctor? — 1. Yes ____ 2. No ____ 8. Does not apply ____ (3)

D. At what age did it start? — ____ Age in years 88 Does not apply ____ (4 - 5)

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Card 2.

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as.

	FATHER			MOTHER			
	1. YES	2. NO	3. DON'T KNOW	1. YES	2. NO	3. DON'T KNOW	
A. Chronic bronchitis?	____	____	____	____	____	____	(29) (30)
B Emphysema?	____	____	____	____	____	____	(31) (32)
C. Asthma?	____	____	____	____	____	____	(33) (34)
D Lung cancer?	____	____	____	____	____	____	(35) (36)
E. Other chest conditions?	____	____	____	____	____	____	(37) (38)
F. Is parent currently alive?	____	____	____	____	____	____	(39) (40)
G. Please Specify							
____ Age if living				____ Age if living			(41) (42)
____ Age at death				____ Age at death			(43) (44)
8. Don't know ____				8. Don't know ____			
H. Please specify cause of death.							
____				____			(45) (46)

These questions pertain mainly to your chest. Please answer *yes* or *no* if possible. If a question does not appear to be applicable to you, check the *does not apply* space. If you are in doubt about whether your answer is *yes* or *no*, record *no*.

COUGH

32. Do you usually have a cough? (Count a cough with first smoke or on first going out-of-doors. Exclude clearing of throat.) [If *no*, skip to Question 32C.] 1. Yes ____ 2. No ____ (47)

B. Do you usually cough as much as 4 to 6 times a day, 4 or more days out of the week? 1. Yes ____ 2. No ____ (48)

C. Do you usually cough at all on getting up, or first thing in the morning? 1. Yes ____ 2. No ____ (49)

D. Do you usually cough at all during the rest of the day or at night? 1. Yes ____ 2. No ____ (50)

IF *YES* TO ANY OF ABOVE (32A, B, C, OR D), ANSWER THE FOLLOWING:
IF *NO* TO ALL, CHECK *DOES NOT APPLY* AND SKIP TO NEXT PAGE.

E. Do you usually cough like this on most days for 3 consecutive months or more during the year? 1. Yes ____ 2. No ____ (51)
8. Does not apply ____

F. For how many years have you had this cough? ____ Number of years (52 - 53)
88. Does not apply ____

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BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A.
Nature of condition(s): _____ (74)

38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? 1. Yes ___ 2. No ___ (75)

IF *YES* TO 38A

B. Do you have to walk slower than people of your age on the level because of breathlessness? 1. Yes ___ 2. No ___ 8. Does not apply ___ (76)

C. Do you ever have to stop for breath when walking at your own pace on the level? 1. Yes ___ 2. No ___ 8. Does not apply ___ (77)

D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? 1. Yes ___ 2. No ___ 8. Does not apply ___ (78)

E. Are you too breathless to leave the house or breathless on dressing or undressing? 1. Yes ___ 2. No ___ 8. Does not apply ___ (79)

TOBACCO SMOKING

39A. Have you ever smoked cigarettes? (*No* means less than 20 packs of cigarettes or 12 oz of tobacco in a lifetime or less than 1 cigarette a day for 1 year. 1. Yes ___ 2. No ___ (1) CARD 3

IF *YES* TO 39A

B. Do you now smoke cigarettes (as of 1 month ago)? 1. Yes ___ 2. No ___ 8. Does not apply ___ (2)

C. How old were you when you first started regular cigarette smoking? ___ Age in years 88. Does not apply ___ (3 - 4)

D. If you have stopped smoking cigarettes completely, how old were you when you stopped? ___ Age stopped Check if still smoking ___ 88. Does not apply ___ (5 - 6)

E. How many cigarettes do you smoke per day now? ___ Cigarettes per day 88. Does not apply ___ (7 - 8)

F. On the average of the entire time you smoked, how many cigarettes did you smoke per day? ___ Cigarettes per day 88. Does not apply ___ (9 - 10)

G. Do or did you inhale the cigarette smoke? 1. Does not apply ___ 2. Not at all ___ 3. Slightly ___ 4. Moderately ___ 5. Deeply ___ (11)

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APPENDIX A(2) : **PERIODIC MEDICAL EXAMINATION**
PRIVATE AND CONFIDENTIAL

QUESTIONNAIRE - SELF-COMPLETION

Thank you for your willingness to participate; your cooperation is very important to the success of our medical program.

This is a questionnaire you are asked to fill out. Please answer the questions as frankly and accurately as possible. ALL INFORMATION OBTAINED IN THE STUDY WILL BE KEPT CONFIDENTIAL AND USED FOR MEDICAL PURPOSES ONLY. Your personal physician will be informed about the test results if you desire.

The questions can be answered by checking the best answer or by filling in a blank with a number or word.

Example: Do you live in the United States 1. Yes ✓
2. No. ___

If you desire help in answering a question, please put a check (✓) in *front* of the question number. You will be helped with these questions at the time of your appointment.

1. NAME: _____

2. SOCIAL SECURITY # ___ ___ ___ ___ ___ ___ ___ ___ ___
1 2 3 4 5 6 7 8 9

3 CLOCK NUMBER ___ ___ ___ ___ ___ ___
10 11 12 13 14 15

4. PRESENT OCCUPATION: _____

5. PLANT: _____

6. ADDRESS: _____

7. _____
(Zip Code)

8. TELEPHONE NUMBER: _____

9. INTERVIEWER: _____

10. DATE: _____ ___ ___ ___ ___ ___ ___
16 17 18 19 20 21

11. Date of Birth: _____ ___ ___ ___ ___ ___ ___
Month Day Year 22 23 24 25 26 27
MO DAY YR

12. Place of Birth: _____ (28-31)

14. What is your marital status? 1. Single ___ (33)
2. Married ___
3. Widowed ___
4. Separated/Divorced ___

17J. Total years exposed to asbestos ..... _____

17K. Date of first exposure to asbestos ..... _____

For Office Use

Card 1

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For Office Use

Card 2

26. Have you had:

A. Any other chest illness? 1. Yes ___ 2. No ___ (18)
If yes, please specify _____

B. Any chest operations? 1. Yes ___ 2. No ___ (19)
If yes, please specify _____

C. Any chest injuries? 1. Yes ___ 2. No ___ (20)
If yes, please specify _____

27A. Has a doctor told you that you had heart trouble? 1. Yes ___ 2. No ___ (21)

IF *YES* to 27A: _____

B. Have you ever had treatment for heart trouble in the past 10 years? 1. Yes ___ 2. No ___ 8. Does not apply ___ (22)

28A. Has a doctor told you that you had high blood pressure? 1. Yes ___ 2. No ___ (23)

IF YES TO 28A: _____

B. Have you had any treatment for high blood pressure (hypertension) in the past 10 years? 1. Yes ___ 2. No ___ 8. Does not apply ___ (24)

29A. When did you last have your chest X-rayed (Year)? . . . ___ ___ ___ ___ (25 26 27 28)

30. Where did you last have your chest X-rayed (if known)?

_____

What was the outcome? (explain) _____

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:

	FATHER			MOTHER			
	1. YES	2. NO	3. DON'T KNOW	1. YES	2. NO	3. DON'T KNOW	
A. Chronic bronchitis?	___	___	___	___	___	___	(29) (30)
B Emphysema?	___	___	___	___	___	___	(31) (32)
C. Asthma?	___	___	___	___	___	___	(33) (34)
D. Lung cancer?	___	___	___	___	___	___	(35) (36)
E Other chest conditions?	___	___	___	___	___	___	(37) (38)
F. Is parent currently alive?	___	___	___	___	___	___	(39) (40)
G. Please Specify	___ Age if living			___ Age if living			(41) (42)
	___ Age at death			___ Age at death			(43) (44)
	8. Don't know ___			8. Don't know ___			
H. Please specify cause of death.	_____			_____			(45) (46)

01293

For Office Use

EPISODES OF COUGH AND PHLEGM

34A. Have you had periods or episodes of (increased*) cough and phlegm lasting for 3 weeks or more each year? 1. Yes ___ 2. No ___ (61)
*(For persons who usually have cough and/or phlegm)

IF *YES* TO 34A:
B. For how long have you had at least 1 such episode per year? _____ Number of years (62 - 63)
88. Does not apply ___

WHEEZING

35A. Does your chest ever sound wheezy or whistling:
1. When you have a cold? 1. Yes ___ 2. No ___ (64)
2. Occasionally apart from colds? 1. Yes ___ 2. No ___ (65)
3. Most days or nights? 1. Yes ___ 2. No ___ (66)

IF *YES* TO 1, 2, OR 3 IN 35A:
B. For how many years has this been present? _____ Number of years (67 - 68)
88. Does not apply ___

36A. Have you ever had an attack of wheezing that has made you feel short of breath? 1. Yes ___ 2. No ___ (69)

IF *YES* TO 36A:
B. How old were you when you had your first such attack? _____ Age in years (70 - 71)
88. Does not apply ___
C. Have you had 2 or more such episodes? 1. Yes ___ 2. No ___ (72)
8. Does not apply ___
D. Have you ever required medicine or treatment for the(se) attack(s)? 1. Yes ___ 2. No ___ (73)
8. Does not apply ___

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to Question 39A.
Nature of condition(s): _____ (74)

38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? 1. Yes ___ 2. No ___ (75)

IF *YES* TO 38A:
B. Do you have to walk slower than people of your age on the level because of breathlessness? 1. Yes ___ 2. No ___ (76)
8. Does not apply ___
C. Do you ever have to stop for breath when walking at your own pace on the level? 1. Yes ___ 2. No ___ (77)
8. Does not apply ___
D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? 1. Yes ___ 2. No ___ (78)
8. Does not apply ___
E. Are you too breathless to leave the house or breathless on dressing or undressing? 1. Yes ___ 2. No ___ (79)
8. Does not apply ___

012995

For Office Use

41A. Have you ever smoked cigars regularly? (*Yes* means more than 1 cigar a week for a year.) 1. Yes ___ 2. No ___ (22) CARD 3

IF *YES* TO 41A:

FOR PERSONS WHO HAVE EVER SMOKED CIGARS:

B. 1. How old were you when you started smoking cigars regularly? ___ Age (23 - 24)

2. If you have stopped smoking cigars completely, how old were you when you stopped? ___ Age stopped (25 - 26)
Check if still smoking cigars ___
88. Does not apply ___

C. On the average, over the entire time you smoked cigars, how many cigars did you smoke per week? ___ Cigars per week (27 - 28)
88. Does not apply ___

D. How many cigars are you smoking per week now? ___ Cigars per week (29 - 30)
88. Check if not smoking cigars currently ___

E. Do or did you inhale the cigar smoke? (31)
1. Never smoked ___
2. Not at all ___
3. Slightly ___
4. Moderately ___
5. Deeply ___

01096

Appendix B

Appendix B (1)

Specifications for Chest Roentgenographic Examinations for use in the Medical Surveillance of Persons Exposed to Asbestos.

(a) Every plan for chest roentgenographic examinations of persons exposed to asbestos shall be submitted for approval by the Assistant Secretary of Labor or designated representative within 120 calendar days after (insert the effective date of these regulations).

(b) The name, address and telephone numbers of the employer(s) submitting the plan shall be provided to the Assistant Secretary of Labor or designated representative.

(c) The name, address and telephone numbers of the physician who will interpret and classify the roentgenograms shall be provided to the Assistant Secretary of Labor or the Secretary's designated representative.

(d) Every chest roentgenogram shall be a single posteroanterior projection at full inspiration on a 14- by 17-inch film. The film and cassette shall be capable of being positioned both vertically and horizontally so that the chest roentgenogram will include both apices and costophrenic angles. If a person is too large to permit the above requirements, then the projection shall include both apices with minimum loss of the costophrenic angle.

01897

(e) The employee shall be disrobed from the waist up at the time the roentgenogram is given. The facility shall provide a dressing area and for those persons who wish to use one, the facility shall provide a clean gown. Facilities shall be heated to a comfortable temperature.

(f) Roentgenograms shall be made only with a diagnostic X-ray machine having a rotating anode tube with a maximum of a 2 mm. source (focal spot).

(g) Except as provided in paragraph (h) of this section, roentgenograms shall be made with units having generators which comply with the following (1) The generators of existing roentgenographic units acquired by the examining facility prior to July 27, 1973, shall have a minimum rating of 200 mA at 100 kVp,; (2) generators of units acquired subsequent to that date shall have a minimum rating of 300 mA at 125 kVp.

NOTE: A generator with a rating of 150 kVp, is recommended.

(h) Roentgenograms made with battery-powered mobile or portable equipment shall be made with units having a minimum rating of 100 mA at 110 kVp. at 500 Hz, or of 200 mA at 110 kVp, at 60 Hz.

(i) Capacitor discharge and field emission units may be used if the model of such units is approved by OSHA for quality, performance, and safety. OSHA will consider such units for approval when listed by a facility seeking approval.

01898

(j) Roentgenograms shall be given only with equipment having a beam-limiting device which does not cause large unexposed boundaries. The beam limiting device shall provide rectangular collimation and shall be of the type described in part F of the suggested State regulations for the control of radiation of (for beam limiting devices manufactured after August 1, 1974) of the type specified in 21 CFR 1020.31. The use of such a device shall be discernible from an examination of the roentgenogram.

(k) to insure high quality chest roentgenograms:

(1) The maximum exposure time shall not exceed 1/20 of a second except that with single phase units with a rating less than 300 mA at 125 kVp. and subjects with chests over 28 cm. posteroanterior, the exposure may be increased to not more than 1/10 of a second;

(2) The source or focal spot to film distance shall be at least 6 feet;

(3) Medium-speed film and medium speed intensifying screens shall be used;

(4) Film-screen contact shall be maintained and verified at 6 month or shorter intervals;

012309

(5) Intensifying screens shall be inspected at least once a month and cleaned when necessary by the method recommended by the manufacturer;

(6) All intensifying screens in a cassette shall be of the same type and made by the same manufacturer;

(7) When using over 90 kV., a suitable grid or other means of reducing scattered radiation shall be used;

(8) The geometry of the radiographic system shall insure that the central axis (ray) of the primary beam is perpendicular to the plane of the film surface and impinges on the center of the film;

(9) A formal quality assurance program shall be established at each facility.

(l) Radiographic processing:

(1) Either automatic or manual film processing is acceptable. A constant time-temperature technique shall be meticulously employed for manual processing.

(2) If mineral or other impurities in the processing water introduce difficulty in obtaining a high-quality roentgenogram, a suitable filter or purification system shall be used.

01810

(m) Before the employee is advised that the examination is concluded, the roentgenogram shall be processed and inspected and accepted for quality by the physician, or if the physician is not available, acceptance may be made by the radiologic technologist. In a case of a substandard roentgenogram, another shall be immediately made. All substandard roentgenograms shall be clearly marked as rejected and promptly sent for disposal.

(n) An electrical power supply shall be used which complies with the voltage, current, and regulation specified by the manufacturer of the machine.

(o) A densitometric test object may be required on each roentgenogram for an objective evaluation of film quality.

(p) Each roentgenogram made hereunder shall be permanently and legibly marked with the name and address or approval number of the facility at which it is made, the social security number of the employee and the date of the roentgenogram.

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Appendix B

Appendix B(2)

SPECIFICATIONS FOR INTERPRETATION,

CLASSIFICATION, AND SUBMISSION OF

CHEST ROENTGENOGRAMS

Interpreting and classifying chest roentgenograms.

(a) Chest roentgenograms shall be interpreted and classified in accordance with the ILO-U/C classification system and recorded on a Roentgenographic Interpretation Form (Form CSD/NIOSH (M) 2.8).

(b) Roentgenograms shall be interpreted and classified only by a physician who regularly reads chest roentgenograms and who has demonstrated proficiency in the use of the ILO-U/C classification system.

(c) All interpreters, whenever interpreting chest roentgenograms made under the act, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

(d) Proficiency in evaluating chest roentgenograms for roentgenographic quality and in the use of the ILO-U/C classification for interpreting

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chest roentgenograms for pneumoconiosis and other diseases shall be demonstrated by those physicians who desire to be "B" readers by taking and passing a specially designed proficiency examination given on behalf of or by NIOSH at a time and place specified by NIOSH. Each physician must bring a complete set of the ILO-U/C standard reference radiographs when taking the examination.

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Appendix C

Appendix C(1) - Pulmonary Function Standards for Asbestos Standard

The spirometric measurements of pulmonary function shall conform to the following minimum standard, and these standards are not intended to preclude additional testing or alternate methods which can be determined to be superior.

I. APPARATUS

(a) The instrument shall be accurate to within ±50 milliliters or within ±3 percent of reading, whichever is greater.

(b) The instrument should be capable of measuring vital capacity from 0 to 7 liters BTPS.

(c) The instrument shall have a low inertia and offer low resistance to airflow such that the resistance to airflow at 12 liters per second must be less than 1.5 cm H_2O/(liter/sec).

(d) The zero time point for the purpose of timing the FEV_1 shall be determined by extrapolating the steepest portion of the volume time curve back to the maximal inspiration volume (1,2,3,4) or by an equivalent method.

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(e) Instruments incorporating measurements of airflow to determine volume shall conform to the same volume accuracy stated in (a) of this section when presented with flow rates from at least 0 to 12 liters per second.

(f) The instrument or user of the instrument must have a means of correcting volumes to body temperature saturated with water vapor (BTPS) under conditions of varying ambient spirometer temperatures and barometric pressures.

(g) The instrument used shall provide a tracing or display of either flow versus volume versus time during the entire forced expiration. A tracing or display is necessary to determine whether the patient has performed the test properly. The tracing must be stored and available for recall and must be of sufficient size that hand meaurements may be made within requirement of paragraph (a) of this secrion. If a paper record is made it must have a paper speed of at least 2 cm/sec and a volume senesitivity of at least 10.0 mm of chart per liter of volume.

(h) The instrument shall be capable of accumulating for a minimum of 10 seconds and shall not stop accumulating volume before (1) the volume change for a 0.5 second interval is less than 25 milliliters, or (2) the flow is less than 50 milliliters per second for a 0.5 second interval.

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(i) The forced vital capacity (FVC) and forced expiratory volume in 1 second ($FEV_{1.0}$) measurements shall comply with the accurance requirements stated in paragraph (a) of this section. That is, they should be accurately measured to within ±50 ml or within ±3 percent of reading, whichever is greater.

(j) The instrument must be capable of being calibrated in the field with respect to the FEV_1 and FVC. This calibration of the FEV_1 and FVC may be either directly or indirectly through volume and time base measurements. The volume calibration source should provide a volume displacement of at least 2 liters and should be accurate to within ±30 milliliters.

II. TECHNIQUE FOR MEASUREMENT OF FORCED VITAL CAPACITY MANEUVER

(a) Use of a nose clip is recommended but not required. The procedures shall be explained in simple terms to the patient who shall be instructed to loosen any tight clothing and stand in front of the apparatus. The subject may sit, but care should be taken on repeat testing that the same position be used and, if possible, the same spirometer. Particular attention shall be given to insure that the chin is slightly elevated with the neck slightly extended. The patient shall be instructed to make

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a full inspiration from a normal breathing pattern and then blow into the apparatus, without interruption, as hard, fast, and completely as possible. At least three forced expirations shall be carried out. During the maneuvers, the patient shall be observed for compliance with instructions. The expirations shall be checked visually for reproducibility from flow-volume or volume-time tracings or displays. The following efforts shall be judged unacceptable when the patient:

1. has not reached full inspiration preceding the forced expiration,

2. has not used maximal effort during the entire forced expiration,

3. has not continued the expiration for at least 5 seconds or until an obvious plateau in the volume time curve has occurred,

4. has coughed or clsed his glottis,

5. has an obstructed mouthpiece or a leak around the mouthpiece (obstruction due to tongue being placed in front of mouthpiece, false teeth falling in front of mouthpiece, etc.),

6. has an unsatisfactory start of expiration, one characterized by excessive hesitation (or flase starts), and therefore not allowing

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back extrapolation of time 0 (extrapolated volume on the volume time tracing must be less than 10 percent of the FVC),

7. has an excessive variability between the three acceptable curves. The variation between the two largest FVC's and FEV_1's of the three satisfactory tracings should not exceed 10 percent or $\pm$ 100 milliliters, whichever is greater.

(b) Periodic and routine recalibration of the instrument or method for recording FVC and $FEV_{1.0}$ should be prformed using a syringe or other volume source of at least 2 liters.

III. INTERPRETATION OF SPIROGRAM

(a) The first step in evaluating a spirogram should be to determine whether or not the patient has performed the test properly or as described in II above. From the three satisfactory tracings, the forced vital capacity (FVC) and forced expiratory volume in 1 second ($FEV_{1.0}$) shall be measured and recorded. The largest observed FVC and largest observed FEV_1 shall be used in the analysis regardless of the curve(s) on which they occur.

01212

(b) The following guidelines are recommended for the evaluation and management of workers exposed to asbestos dust. It is important to note that employees who show reductions in $FEV_{1.0}$ and FVC below 75% of the predicted values, or reductions in both measured values of 5 percent or greater from their initial screening exam, should be re-evaluated within a period of one month. Those who show consistent decrease in lung function, as compared to the predicted values in Tables 2-5, should be assessed by the physician and a recommendation given with regard to suitability of the employee to continue in an occupation where the potential exists for exposure to airborne concentrations of asbestos fibers in excess of the prescribed action level.

IV. QUALIFICATIONS OF PERSONNEL ADMINISTERING THE TEST

Technicians who perform pulmonary function testing should have the basic knowledge required to produce meaningful results. Training consisting of approximately 16 hours of formal instruction should cover the following areas. Persons who successfully complete the course will be certified by OSHA or their designee.

(a) Basic physiology of the forced vital capacity maneuver and the determinants of airflow limitation with emphasis on the relation to reproducibilty of results.

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(b) Instrumentation requirements including calibration procedures, sources of error and their correction.

(c) Peformance of the testing including subject coaching, recognition of improperly performed maneuvers and corrective actions.

(d) Data quality with emphasis on reproducibility.

(e) Actual use of the equipment under supervised conditions.

(f) Measurements of tracings and calculations of results.

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Appendix C(2) —Spirometry Prediction Tables for Normal Males and Females

TABLE 2. PREDICTED FVC FOR MALES (KNUDSON, ET AL: AM REV RESPIR DIS. 1976. 113. 587.)

HT	AGE 17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
60.0	3.44	3.39	3.75	3.91	3.72	3.66	3.61	3.55	3.49	3.43	3.37	3.32	3.26	3.20	3.14	3.08	3.03	2.97	2.91	2.85	2.79	2.74	2.68	2.62	2.56
60.5	3.50	3.66	3.81	3.97	3.80	3.75	3.69	3.63	3.57	3.51	3.46	3.40	3.34	3.28	3.22	3.17	3.11	3.05	2.99	2.93	2.88	2.82	2.76	2.70	2.64
61.0	3.56	3.72	3.88	4.03	3.89	3.83	3.77	3.71	3.66	3.60	3.54	3.48	3.42	3.37	3.31	3.25	3.19	3.13	3.08	3.02	2.96	2.90	2.84	2.79	2.73
61.5	3.63	3.78	3.94	4.10	3.97	3.91	3.85	3.80	3.74	3.68	3.62	3.56	3.51	3.45	3.39	3.33	3.27	3.22	3.16	3.10	3.04	2.98	2.93	2.87	2.81
62.0	3.69	3.85	4.00	4.16	4.05	3.99	3.94	3.88	3.82	3.76	3.70	3.65	3.59	3.53	3.47	3.41	3.36	3.30	3.24	3.18	3.12	3.07	3.01	2.95	2.89
62.5	3.76	3.91	4.07	4.22	4.13	4.08	4.02	3.96	3.90	3.84	3.79	3.73	3.67	3.61	3.55	3.50	3.44	3.38	3.32	3.26	3.21	3.15	3.09	3.03	2.97
63.0	3.82	3.97	4.13	4.29	4.22	4.16	4.10	4.04	3.99	3.93	3.87	3.81	3.75	3.70	3.64	3.58	3.52	3.46	3.41	3.35	3.29	3.23	3.17	3.12	3.06
63.5	3.88	4.04	4.19	4.35	4.30	4.24	4.18	4.13	4.07	4.01	3.95	3.89	3.84	3.78	3.72	3.66	3.60	3.55	3.49	3.43	3.37	3.31	3.26	3.20	3.14
64.0	3.95	4.10	4.26	4.41	4.38	4.32	4.27	4.21	4.15	4.09	4.03	3.98	3.92	3.86	3.80	3.74	3.69	3.63	3.57	3.51	3.45	3.40	3.34	3.28	3.22
64.5	4.01	4.17	4.32	4.48	4.46	4.41	4.35	4.29	4.23	4.17	4.12	4.06	4.00	3.94	3.88	3.83	3.77	3.71	3.65	3.59	3.54	3.48	3.42	3.36	3.30
65.0	4.07	4.23	4.39	4.54	4.55	4.49	4.43	4.37	4.32	4.26	4.20	4.14	4.08	4.03	3.97	3.91	3.85	3.79	3.74	3.68	3.62	3.56	3.50	3.45	3.39
65.5	4.14	4.29	4.45	4.60	4.63	4.57	4.51	4.46	4.40	4.34	4.28	4.22	4.17	4.11	4.05	3.99	3.93	3.88	3.82	3.76	3.70	3.64	3.59	3.53	3.47
66.0	4.20	4.36	4.51	4.67	4.71	4.65	4.60	4.54	4.48	4.42	4.36	4.31	4.25	4.19	4.13	4.07	4.02	3.96	3.90	3.84	3.78	3.73	3.67	3.61	3.55
66.5	4.26	4.42	4.58	4.73	4.80	4.74	4.68	4.62	4.56	4.51	4.45	4.39	4.33	4.27	4.22	4.16	4.10	4.04	3.98	3.93	3.87	3.81	3.75	3.69	3.64
67.0	4.33	4.48	4.64	4.80	4.88	4.82	4.76	4.70	4.65	4.59	4.53	4.47	4.41	4.36	4.30	4.24	4.18	4.12	4.07	4.01	3.95	3.89	3.83	3.78	3.72
67.5	4.39	4.55	4.70	4.86	4.96	4.90	4.84	4.79	4.73	4.67	4.61	4.55	4.50	4.44	4.38	4.32	4.26	4.21	4.15	4.09	4.03	3.97	3.92	3.86	3.80
68.0	4.45	4.61	4.77	4.92	5.04	4.98	4.93	4.87	4.81	4.75	4.69	4.64	4.58	4.52	4.46	4.40	4.35	4.29	4.23	4.17	4.11	4.06	4.00	3.94	3.88
68.5	4.52	4.67	4.83	4.99	5.13	5.07	5.01	4.95	4.89	4.84	4.78	4.72	4.66	4.60	4.55	4.49	4.43	4.37	4.31	4.26	4.20	4.14	4.08	4.02	3.97
69.0	4.58	4.74	4.89	5.05	5.21	5.15	5.09	5.03	4.98	4.92	4.86	4.80	4.74	4.69	4.63	4.57	4.51	4.45	4.40	4.34	4.28	4.22	4.16	4.11	4.05
69.5	4.64	4.80	4.96	5.11	5.29	5.23	5.17	5.12	5.06	5.00	4.94	4.88	4.83	4.77	4.71	4.65	4.59	4.54	4.48	4.42	4.36	4.30	4.25	4.19	4.13
70.0	4.71	4.86	5.02	5.18	5.37	5.32	5.26	5.20	5.14	5.08	5.02	4.97	4.91	4.85	4.79	4.74	4.68	4.62	4.56	4.50	4.44	4.39	4.33	4.27	4.21
70.5	4.77	4.93	5.08	5.24	5.46	5.40	5.34	5.28	5.22	5.17	5.11	5.05	4.99	4.93	4.88	4.82	4.76	4.70	4.64	4.59	4.53	4.47	4.41	4.35	4.30
71.0	4.83	4.99	5.15	5.30	5.54	5.48	5.42	5.36	5.31	5.25	5.19	5.13	5.07	5.02	4.96	4.90	4.84	4.78	4.73	4.67	4.61	4.55	4.49	4.44	4.38
71.5	4.90	5.05	5.21	5.37	5.62	5.56	5.50	5.45	5.39	5.33	5.27	5.21	5.16	5.10	5.04	4.98	4.92	4.87	4.81	4.75	4.69	4.63	4.58	4.52	4.46
72.0	4.96	5.12	5.27	5.43	5.70	5.65	5.59	5.53	5.47	5.41	5.36	5.30	5.24	5.18	5.12	5.07	5.01	4.95	4.89	4.83	4.78	4.72	4.66	4.60	4.54
72.5	5.03	5.18	5.34	5.49	5.79	5.73	5.67	5.61	5.55	5.50	5.44	5.38	5.32	5.26	5.21	5.15	5.09	5.03	4.97	4.92	4.86	4.80	4.75	4.69	4.63
73.0	5.09	5.24	5.40	5.56	5.87	5.81	5.75	5.69	5.64	5.58	5.52	5.46	5.40	5.35	5.29	5.23	5.17	5.11	5.06	5.00	4.94	4.88	4.82	4.77	4.71
73.5	5.15	5.31	5.46	5.62	5.95	5.89	5.83	5.78	5.72	5.66	5.60	5.54	5.49	5.43	5.37	5.31	5.25	5.20	5.14	5.08	5.02	4.96	4.91	4.85	4.79
74.0	5.22	5.37	5.53	5.68	6.03	5.98	5.92	5.86	5.80	5.74	5.69	5.63	5.57	5.51	5.45	5.40	5.34	5.28	5.22	5.16	5.11	5.05	4.99	4.93	4.87
74.5	5.28	5.44	5.59	5.75	6.12	6.06	6.00	5.94	5.88	5.83	5.77	5.71	5.65	5.59	5.54	5.48	5.42	5.36	5.30	5.25	5.19	5.13	5.07	5.01	4.96
75.0	5.34	5.50	5.65	5.81	6.20	6.14	6.08	6.02	5.97	5.91	5.85	5.79	5.73	5.68	5.62	5.56	5.50	5.44	5.39	5.33	5.27	5.21	5.15	5.10	5.04
75.5	5.41	5.56	5.72	5.87	6.28	6.22	6.17	6.11	6.05	5.99	5.93	5.88	5.82	5.76	5.70	5.64	5.59	5.53	5.47	5.41	5.35	5.30	5.24	5.18	5.12
76.0	5.47	5.63	5.78	5.94	6.36	6.31	6.25	6.19	6.13	6.07	6.02	5.96	5.90	5.84	5.78	5.73	5.67	5.61	5.55	5.49	5.44	5.38	5.32	5.26	5.20
76.5	5.53	5.69	5.85	6.00	6.45	6.39	6.33	6.27	6.21	6.16	6.10	6.04	5.98	5.92	5.87	5.81	5.75	5.69	5.63	5.58	5.52	5.46	5.40	5.34	5.29
77.0	5.60	5.75	5.91	6.06	6.53	6.47	6.41	6.35	6.30	6.24	6.18	6.12	6.06	6.01	5.95	5.89	5.83	5.77	5.72	5.66	5.60	5.54	5.48	5.43	5.37
77.5	5.66	5.82	5.97	6.13	6.61	6.55	6.50	6.44	6.38	6.32	6.26	6.21	6.15	6.09	6.03	5.97	5.92	5.86	5.80	5.74	5.68	5.63	5.57	5.51	5.45
78.0	5.72	5.88	6.04	6.19	6.69	6.64	6.58	6.52	6.46	6.40	6.35	6.29	6.23	6.17	6.11	6.06	6.00	5.94	5.88	5.82	5.77	5.71	5.65	5.59	5.53
78.5	5.79	5.94	6.10	6.26	6.78	6.72	6.66	6.60	6.54	6.49	6.43	6.37	6.31	6.25	6.20	6.14	6.08	6.02	5.96	5.91	5.85	5.79	5.73	5.67	5.62
79.0	5.85	6.01	6.16	6.32	6.86	6.80	6.74	6.68	6.63	6.57	6.51	6.45	6.39	6.34	6.28	6.22	6.16	6.10	6.05	5.99	5.93	5.87	5.81	5.76	5.70
79.5	5.91	6.07	6.23	6.38	6.94	6.88	6.83	6.77	6.71	6.65	6.59	6.54	6.48	6.42	6.36	6.30	6.25	6.19	6.13	6.07	6.01	5.96	5.90	5.84	5.78
80.0	5.98	6.13	6.29	6.45	7.02	6.97	6.91	6.85	6.79	6.73	6.68	6.62	6.56	6.50	6.44	6.39	6.33	6.27	6.21	6.15	6.10	6.04	5.98	5.92	5.86
80.5	6.04	6.20	6.35	6.51	7.11	7.05	6.99	6.93	6.87	6.82	6.76	6.70	6.64	6.58	6.53	6.47	6.41	6.35	6.29	6.24	6.18	6.12	6.06	6.00	5.95
81.0	6.10	6.26	6.42	6.57	7.19	7.13	7.07	7.02	6.96	6.90	6.84	6.78	6.73	6.67	6.61	6.55	6.49	6.44	6.38	6.32	6.26	6.20	6.15	6.09	6.03
81.5	6.17	6.32	6.48	6.64	7.27	7.21	7.16	7.10	7.04	6.98	6.92	6.87	6.81	6.75	6.69	6.63	6.58	6.52	6.46	6.40	6.34	6.29	6.23	6.17	6.11
82.0	6.23	6.39	6.54	6.70	7.35	7.30	7.24	7.18	7.12	7.06	7.01	6.95	6.89	6.83	6.77	6.72	6.66	6.60	6.54	6.48	6.43	6.37	6.31	6.25	6.19
82.5	6.30	6.45	6.61	6.76	7.44	7.38	7.32	7.26	7.20	7.15	7.09	7.03	6.97	6.91	6.86	6.80	6.74	6.68	6.62	6.57	6.51	6.45	6.39	6.33	6.28
83.0	6.36	6.51	6.67	6.83	7.52	7.46	7.40	7.35	7.29	7.23	7.17	7.11	7.06	7.00	6.94	6.88	6.82	6.77	6.71	6.65	6.59	6.53	6.48	6.42	6.36
83.5	6.42	6.58	6.73	6.89	7.60	7.54	7.49	7.43	7.37	7.31	7.25	7.20	7.14	7.08	7.02	6.96	6.91	6.85	6.79	6.73	6.67	6.62	6.56	6.50	6.44
84.0	6.49	6.64	6.80	6.95	7.68	7.63	7.57	7.51	7.45	7.39	7.34	7.28	7.22	7.16	7.10	7.05	6.99	6.93	6.87	6.81	6.76	6.70	6.64	6.58	6.52
84.5	6.55	6.71	6.86	7.02	7.77	7.71	7.65	7.59	7.53	7.48	7.42	7.36	7.30	7.24	7.19	7.13	7.07	7.01	6.95	6.90	6.84	6.78	6.72	6.66	6.61
85.0	6.61	6.77	6.92	7.08	7.85	7.79	7.73	7.68	7.62	7.56	7.50	7.44	7.39	7.33	7.27	7.21	7.15	7.10	7.04	6.98	6.92	6.86	6.81	6.75	6.69

TABLE 3. PREDICTED FEV1 FOR MALES (INDUSM. BT Jn' 74 FEV RESPIR DIS. 1976. 113. 587.)

HT	AGE 17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
60.0	2.97	3.06	3.15	3.24	3.05	2.99	2.94	2.88	2.83	2.78	2.72	2.67	2.61	2.56	2.51	2.45	2.40	2.34	2.29	2.24	2.18	2.13	2.07	2.02	1.97
60.5	3.03	3.12	3.21	3.30	3.11	3.06	3.00	2.95	2.90	2.84	2.79	2.73	2.68	2.63	2.57	2.52	2.46	2.41	2.36	2.30	2.25	2.19	2.14	2.09	2.03
61.0	3.08	3.17	3.26	3.35	3.18	3.12	3.07	3.02	2.96	2.91	2.85	2.80	2.75	2.69	2.64	2.59	2.53	2.48	2.42	2.37	2.31	2.26	2.21	2.15	2.10
61.5	3.14	3.23	3.32	3.41	3.24	3.19	3.14	3.08	3.03	2.97	2.92	2.87	2.81	2.76	2.70	2.65	2.59	2.54	2.49	2.43	2.38	2.33	2.27	2.22	2.16
62.0	3.20	3.29	3.38	3.47	3.31	3.26	3.20	3.15	3.09	3.04	2.99	2.93	2.88	2.82	2.77	2.72	2.66	2.61	2.55	2.50	2.45	2.39	2.34	2.28	2.23
62.5	3.26	3.35	3.44	3.53	3.38	3.32	3.27	3.22	3.16	3.11	3.05	3.00	2.95	2.89	2.84	2.78	2.73	2.68	2.62	2.57	2.51	2.46	2.41	2.35	2.30
63.0	3.32	3.41	3.50	3.59	3.44	3.39	3.34	3.28	3.23	3.17	3.12	3.07	3.01	2.96	2.90	2.85	2.80	2.74	2.69	2.63	2.58	2.53	2.47	2.42	2.36
63.5	3.38	3.47	3.56	3.65	3.51	3.46	3.40	3.35	3.29	3.24	3.19	3.13	3.08	3.02	2.97	2.92	2.86	2.81	2.75	2.70	2.65	2.59	2.54	2.48	2.43
64.0	3.43	3.52	3.61	3.70	3.58	3.52	3.47	3.41	3.36	3.31	3.25	3.20	3.14	3.09	3.04	2.98	2.93	2.87	2.82	2.77	2.71	2.66	2.60	2.55	2.50
64.5	3.49	3.58	3.67	3.76	3.64	3.59	3.53	3.48	3.43	3.37	3.32	3.26	3.21	3.16	3.10	3.05	2.99	2.94	2.89	2.83	2.78	2.72	2.67	2.62	2.56
65.0	3.55	3.64	3.73	3.82	3.71	3.65	3.60	3.55	3.49	3.44	3.38	3.33	3.28	3.22	3.17	3.11	3.06	3.01	2.95	2.90	2.84	2.79	2.74	2.68	2.63
65.5	3.61	3.70	3.79	3.88	3.77	3.72	3.67	3.61	3.56	3.50	3.45	3.40	3.34	3.29	3.23	3.18	3.13	3.07	3.02	2.96	2.91	2.86	2.80	2.75	2.69
66.0	3.67	3.76	3.85	3.94	3.84	3.79	3.73	3.68	3.62	3.57	3.52	3.46	3.41	3.35	3.30	3.25	3.19	3.14	3.08	3.03	2.98	2.92	2.87	2.81	2.76
66.5	3.73	3.82	3.91	4.00	3.90	3.85	3.80	3.74	3.69	3.64	3.58	3.53	3.47	3.42	3.37	3.31	3.26	3.20	3.15	3.10	3.04	2.99	2.93	2.88	2.83
67.0	3.79	3.88	3.97	4.06	3.97	3.92	3.86	3.81	3.75	3.70	3.65	3.59	3.54	3.49	3.43	3.38	3.32	3.27	3.22	3.16	3.11	3.05	3.00	2.95	2.89
67.5	3.84	3.93	4.02	4.11	4.04	3.98	3.93	3.88	3.82	[illegible]	3.71	3.66	3.61	3.55	3.50	3.44	3.39	3.34	3.28	3.23	3.17	3.12	3.07	3.01	2.96
68.0	3.90	3.99	4.08	4.17	4.10	4.05	4.00	3.94	3.89	3.[illegible]	[illegible]	3.73	3.67	3.62	3.56	3.51	3.46	3.40	3.35	3.29	3.24	3.19	3.13	3.08	3.02
68.5	3.96	4.05	4.14	4.23	4.17	4.12	4.06	4.01	3.95	3.90	[illegible]	3.79	3.74	3.68	3.63	3.58	3.52	3.47	3.41	3.36	3.31	3.25	3.20	3.14	3.09
69.0	4.02	4.11	4.20	4.29	4.24	4.18	4.13	4.07	4.02	3.97	3.91	3.86	3.80	3.75	3.70	3.64	3.59	3.53	3.48	3.43	3.37	3.32	3.26	3.21	3.16
69.5	4.08	4.17	4.26	4.35	4.30	4.25	4.19	4.14	4.09	4.03	3.98	3.92	3.87	3.82	3.76	3.71	3.65	3.60	3.55	3.49	3.44	3.38	3.33	3.28	3.22
70.0	4.14	4.23	4.32	4.41	4.37	4.31	4.26	4.21	4.15	4.09	4.04	3.99	3.94	3.88	3.83	3.77	3.72	3.67	3.61	3.56	3.50	3.45	3.40	3.34	3.29
70.5	4.19	4.28	4.37	4.46	4.43	4.37	4.33	4.27	4.22	4.15	4.11	4.06	4.00	3.93	3.89	3.84	3.79	3.73	3.68	3.62	3.57	3.52	3.46	3.41	3.35
71.0	4.25	4.34	4.43	4.52	4.50	4.45	4.39	4.34	4.28	4.23	4.18	4.12	4.07	4.01	3.96	3.91	3.85	3.80	3.74	3.69	3.64	3.58	3.53	3.47	3.42
71.5	4.31	4.40	4.49	4.58	4.57	4.51	4.46	4.40	4.35	4.30	4.24	4.19	4.13	4.08	4.03	3.97	3.92	3.86	3.81	3.76	3.70	3.65	3.59	3.54	3.49
72.0	4.37	4.46	4.55	4.64	4.63	4.58	4.52	4.47	4.42	4.36	4.31	4.25	4.20	4.15	4.09	4.04	3.98	3.93	3.88	3.82	3.77	3.71	3.66	3.61	3.55
72.5	4.43	4.52	4.61	4.70	4.70	4.64	4.59	4.54	4.48	4.43	4.37	4.32	4.27	4.21	4.16	4.10	4.05	4.00	3.94	3.89	3.83	3.78	3.73	3.67	3.62
73.0	4.49	4.58	4.67	4.76	4.76	4.71	4.66	4.60	4.55	4.49	4.44	4.39	4.33	4.28	4.22	4.17	4.12	4.06	4.01	3.95	3.90	3.85	3.79	3.74	3.68
73.5	4.54	4.63	4.72	4.81	4.82	4.76	4.72	4.67	4.61	4.56	4.51	4.45	4.40	4.34	4.29	4.24	4.18	4.13	4.07	4.02	3.97	3.91	3.86	3.80	3.75
74.0	4.60	4.69	4.78	4.87	4.88	4.82	4.79	4.73	4.68	4.63	4.57	4.52	4.46	4.41	4.36	4.30	4.25	4.19	4.14	4.09	4.03	3.98	3.92	3.87	3.82
74.5	4.66	4.75	4.84	4.93	4.94	4.88	4.85	4.80	4.75	4.69	4.64	4.58	4.53	4.48	4.42	4.37	4.31	4.26	4.21	4.15	4.10	4.04	3.99	3.94	3.88
75.0	4.72	4.81	4.90	4.99	5.00	4.94	4.92	4.87	4.81	4.76	4.70	4.65	4.60	4.54	4.49	4.43	4.38	4.33	4.27	4.22	4.16	4.11	4.06	4.00	3.95
75.5	4.78	4.87	4.96	5.05	5.06	5.00	4.99	4.93	4.88	4.82	4.77	4.72	4.66	4.61	4.55	4.50	4.45	4.39	4.34	4.28	4.23	4.18	4.12	4.07	4.01
76.0	4.84	4.93	5.02	5.11	5.12	5.06	5.05	5.00	4.94	4.89	4.84	4.78	4.73	4.67	4.62	4.57	4.51	4.46	4.40	4.35	4.30	4.24	4.19	4.13	4.08
76.5	4.89	4.99	5.08	5.17	5.18	5.12	5.11	5.06	5.01	4.96	4.90	4.85	4.79	4.74	4.69	4.63	4.58	4.52	4.47	4.42	4.36	4.31	4.25	4.20	4.15
77.0	4.95	5.04	5.13	5.22	5.23	5.18	5.17	5.12	5.06	5.02	4.97	4.91	4.86	4.81	4.75	4.70	4.64	4.59	4.54	4.48	4.43	4.37	4.32	4.27	4.21
77.5	5.01	5.10	5.19	5.28	5.29	5.24	5.23	5.18	5.13	5.08	5.02	4.97	4.91	4.86	4.81	4.76	4.71	4.66	4.60	4.55	4.49	4.44	4.39	4.33	4.28
78.0	5.07	5.16	5.25	5.34	5.35	5.30	5.29	5.24	5.19	5.14	5.09	5.03	4.98	4.93	4.87	4.82	4.76	4.72	4.67	4.61	4.56	4.51	4.45	4.40	4.34
78.5	5.13	5.22	5.31	5.40	5.41	5.36	5.35	5.30	5.25	5.20	5.15	5.10	5.05	4.99	4.94	4.88	4.83	4.78	4.73	4.68	4.63	4.57	4.52	4.46	4.41
79.0	5.19	5.28	5.37	5.46	5.47	5.42	5.41	5.36	5.31	5.26	5.21	5.16	5.11	5.06	5.00	4.95	4.90	4.84	4.79	4.74	4.68	4.63	4.58	4.52	4.47
79.5	5.25	5.34	5.43	5.52	5.53	5.48	5.47	5.42	5.37	5.32	5.27	5.22	5.17	5.11	5.06	5.01	4.96	4.91	4.85	4.80	4.75	4.69	4.64	4.58	4.53
80.0	5.30	5.39	5.48	5.57	5.58	5.53	5.53	5.47	5.42	5.37	5.32	5.27	5.22	5.17	5.11	5.06	5.01	4.96	4.90	4.85	4.80	4.74	4.69	4.63	4.58
80.5	5.36	5.45	5.54	5.63	5.63	5.59	5.58	5.54	5.48	5.43	5.38	5.32	5.27	5.21	5.16	5.11	5.05	5.00	4.94	4.89	4.84	4.78	4.73	4.68	4.62
81.0	5.42	5.51	5.60	5.69	5.70	5.65	5.64	5.60	5.55	5.49	5.44	5.39	5.33	5.28	5.23	5.17	5.12	5.06	5.01	4.96	4.90	4.85	4.79	4.74	4.68
81.5	5.48	5.57	5.66	5.75	5.76	5.71	5.70	5.66	5.60	5.55	5.50	5.44	5.39	5.33	5.28	5.23	5.17	5.12	5.07	5.02	4.97	4.91	4.86	4.81	4.75
82.0	5.54	5.63	5.72	5.81	5.82	5.77	5.76	5.72	5.67	5.62	5.56	5.51	5.45	5.40	5.35	5.29	5.24	5.18	5.13	5.08	5.02	4.97	4.91	4.86	4.81
82.5	5.60	5.69	5.78	5.87	5.88	5.83	5.82	5.78	5.73	5.68	5.63	5.57	5.52	5.47	5.41	5.36	5.30	5.25	5.20	5.14	5.09	5.03	4.98	4.93	4.87
83.0	5.65	5.74	5.83	5.92	5.93	5.89	5.88	5.83	5.79	5.74	5.69	5.64	5.59	5.53	5.48	5.42	5.37	5.32	5.26	5.21	5.15	5.10	5.05	4.99	4.94
83.5	5.71	5.80	5.89	5.98	6.00	5.95	5.93	5.89	5.84	5.80	5.75	5.70	5.65	5.60	5.54	5.49	5.44	5.38	5.33	5.27	5.22	5.17	5.11	5.06	5.00
84.0	5.77	5.86	5.95	6.04	6.06	6.01	5.99	5.95	5.90	5.86	5.81	5.76	5.71	5.65	5.61	5.56	5.50	5.45	5.39	5.34	5.29	5.23	5.18	5.12	5.07
84.5	5.83	5.92	6.01	6.10	6.12	6.07	6.06	6.01	5.96	5.91	5.86	5.81	5.76	5.71	5.66	5.61	5.56	5.51	5.45	5.40	5.34	5.29	5.24	5.19	5.14
85.0	5.89	5.98	6.07	6.16	6.18	6.13	6.12	6.07	6.02	5.97	5.92	5.87	5.82	5.77	5.72	5.67	5.62	5.57	5.51	5.46	5.41	5.35	5.30	5.25	5.20

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TABLE 4. PREDICTED FEV1 FOR FEMALES (NONSMOK. ET AL: AM REV RESPIR DIS. 1976. 113. 587.)

HT	17	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
52.0	2.31	2.41	2.33	2.29	2.25	2.21	2.16	2.12	2.08	2.04	2.00	1.95	1.91	1.87	1.83	1.79	1.74	1.70	1.66	1.62	1.58	1.53	1.49	1.45	1.41
52.5	2.34	2.51	2.37	2.32	2.28	2.24	2.20	2.16	2.11	2.07	2.03	1.99	1.95	1.90	1.86	1.82	1.78	1.74	1.69	1.65	1.61	1.57	1.53	1.48	1.44
53.0	2.38	2.55	2.40	2.36	2.32	2.27	2.23	2.19	2.15	2.11	2.06	2.02	1.98	1.94	1.90	1.85	1.81	1.77	1.73	1.69	1.64	1.60	1.56	1.52	1.48
53.5	2.41	2.58	2.43	2.39	2.35	2.31	2.27	2.22	2.18	2.14	2.10	2.06	2.01	1.97	1.93	1.89	1.85	1.80	1.76	1.72	1.68	1.64	1.59	1.55	1.51
54.0	2.45	2.62	2.47	2.43	2.38	2.34	2.30	2.26	2.22	2.17	2.13	2.09	2.05	2.01	1.96	1.92	1.88	1.84	1.80	1.75	1.71	1.67	1.63	1.59	1.54
54.5	2.48	2.65	2.50	2.46	2.42	2.38	2.33	2.29	2.25	2.21	2.17	2.12	2.08	2.04	2.00	1.96	1.91	1.87	1.83	1.79	1.75	1.70	1.66	1.62	1.58
55.0	2.51	2.68	2.54	2.49	2.45	2.41	2.37	2.33	2.28	2.24	2.20	2.16	2.12	2.07	2.03	1.99	1.95	1.91	1.86	1.82	1.78	1.74	1.70	1.65	1.61
55.5	2.55	2.72	2.57	2.53	2.49	2.45	2.40	2.36	2.32	2.28	2.24	2.19	2.15	2.11	2.07	2.03	1.98	1.94	1.90	1.86	1.82	1.77	1.73	1.69	1.65
56.0	2.58	2.75	2.61	2.56	2.52	2.48	2.44	2.40	2.35	2.31	2.27	2.23	2.19	2.14	2.10	2.06	2.02	1.98	1.93	1.89	1.85	1.81	1.77	1.72	1.68
56.5	2.62	2.78	2.64	2.60	2.56	2.51	2.47	2.43	2.39	2.35	2.30	2.26	2.22	2.18	2.14	2.09	2.05	2.01	1.97	1.93	1.88	1.84	1.80	1.76	1.72
57.0	2.65	2.82	2.67	2.63	2.59	2.55	2.51	2.46	2.42	2.38	2.34	2.30	2.25	2.21	2.17	2.13	2.09	2.04	2.00	1.96	1.92	1.88	1.83	1.79	1.75
57.5	2.69	2.86	2.71	2.67	2.62	2.58	2.54	2.50	2.46	2.41	2.37	2.33	2.29	2.25	2.20	2.16	2.12	2.08	2.04	1.99	1.95	1.91	1.87	1.83	1.78
58.0	2.72	2.89	2.75	2.70	2.66	2.62	2.57	2.53	2.49	2.45	2.41	2.36	2.32	2.28	2.24	2.20	2.15	2.11	2.07	2.03	1.99	1.94	1.90	1.86	1.82
58.5	2.75	2.92	2.78	2.74	2.69	2.65	2.61	2.57	2.52	2.48	2.44	2.40	2.36	2.31	2.27	2.23	2.19	2.15	2.10	2.06	2.02	1.98	1.94	1.89	1.85
59.0	2.79	2.96	2.81	2.77	2.73	2.69	2.64	2.60	2.56	2.52	2.48	2.43	2.39	2.35	2.31	2.27	2.22	2.18	2.14	2.10	2.06	2.01	1.97	1.93	1.89
59.5	2.82	2.99	2.84	2.80	2.76	2.72	2.68	2.64	2.59	2.55	2.51	2.47	2.43	2.38	2.34	2.30	2.26	2.22	2.17	2.13	2.09	2.05	2.01	1.96	1.92
60.0	2.86	3.03	2.88	2.84	2.80	2.75	2.71	2.67	2.63	2.59	2.54	2.50	2.46	2.42	2.38	2.33	2.29	2.25	2.21	2.17	2.12	2.08	2.04	2.00	1.96
60.5	2.89	3.06	2.91	2.87	2.83	2.79	2.74	2.70	2.66	2.62	2.58	2.54	2.49	2.45	2.41	2.37	2.33	2.28	2.24	2.20	2.16	2.12	2.07	2.03	1.99
61.0	2.93	3.10	2.95	2.91	2.86	2.82	2.78	2.74	2.70	2.65	2.61	2.57	2.53	2.49	2.44	2.40	2.36	2.32	2.28	2.23	2.19	2.15	2.11	2.07	2.02
61.5	2.96	3.13	2.98	2.94	2.90	2.86	2.81	2.77	2.73	2.69	2.65	2.60	2.56	2.52	2.48	2.44	2.39	2.35	2.31	2.27	2.23	2.18	2.14	2.10	2.06
62.0	2.99	3.16	3.02	2.97	2.93	2.89	2.85	2.81	2.76	2.72	2.68	2.64	2.60	2.55	2.51	2.47	2.43	2.39	2.34	2.30	2.26	2.22	2.18	2.13	2.09
62.5	3.03	3.20	3.05	3.01	2.97	2.93	2.88	2.84	2.80	2.76	2.72	2.67	2.63	2.59	2.55	2.51	2.47	2.42	2.38	2.34	2.30	2.25	2.21	2.17	2.13
63.0	3.06	3.23	3.09	3.04	3.00	2.96	2.92	2.88	2.83	2.79	2.75	2.71	2.67	2.62	2.58	2.54	2.50	2.46	2.41	2.37	2.33	2.29	2.25	2.20	2.16
63.5	3.10	3.27	3.12	3.08	3.03	2.99	2.95	2.91	2.87	2.83	2.78	2.74	2.70	2.66	2.62	2.57	2.53	2.49	2.45	2.41	2.36	2.32	2.28	2.24	2.20
64.0	3.13	3.30	3.15	3.11	3.07	2.99	2.94	2.90	2.86	2.82	2.78	2.73	2.69	2.65	2.61	2.57	2.52	2.48	2.44	2.40	2.36	2.31	2.27	2.23	
64.5	3.17	3.34	3.19	3.15	3.10	3.06	3.02	2.98	2.94	2.89	2.85	2.81	2.77	2.73	2.68	2.64	2.60	2.56	2.52	2.47	2.43	2.39	2.35	2.31	2.26
65.0	3.20	3.37	3.22	3.18	3.14	3.10	3.05	3.01	2.97	2.93	2.89	2.84	2.80	2.76	2.72	2.68	2.63	2.59	2.55	2.51	2.47	2.42	2.38	2.34	2.30
65.5	3.23	3.40	3.26	3.21	3.17	3.13	3.09	3.05	3.00	2.96	2.92	2.88	2.84	2.79	2.75	2.71	2.67	2.63	2.58	2.54	2.50	2.46	2.42	2.37	2.33
66.0	3.27	3.44	3.29	3.25	3.21	3.17	3.12	3.08	3.04	3.00	2.96	2.91	2.87	2.83	2.79	2.75	2.70	2.66	2.62	2.58	2.54	2.49	2.45	2.41	2.37
66.5	3.30	3.47	3.33	3.28	3.24	3.20	3.16	3.12	3.08	3.03	2.99	2.95	2.91	2.86	2.82	2.78	2.74	2.70	2.65	2.61	2.57	2.53	2.49	2.44	2.40
67.0	3.34	3.51	3.36	3.32	3.28	3.23	3.19	3.15	3.11	3.07	3.02	2.98	2.94	2.90	2.86	2.81	2.77	2.73	2.69	2.65	2.60	2.56	2.52	2.48	2.44
67.5	3.37	3.54	3.39	3.35	3.31	3.27	3.23	3.18	3.14	3.10	3.06	3.02	2.97	2.93	2.89	2.85	2.81	2.76	2.72	2.68	2.64	2.60	2.55	2.51	2.47
68.0	3.41	3.58	3.43	3.39	3.34	3.30	3.26	3.22	3.18	3.13	3.09	3.05	3.01	2.97	2.92	2.88	2.84	2.80	2.76	2.71	2.67	2.63	2.59	2.55	2.50
68.5	3.44	3.61	3.46	3.42	3.38	3.34	3.29	3.25	3.21	3.17	3.13	3.08	3.04	3.00	2.96	2.92	2.87	2.83	2.79	2.75	2.71	2.66	2.62	2.58	2.54
69.0	3.47	3.64	3.50	3.46	3.41	3.37	3.33	3.29	3.25	3.20	3.16	3.12	3.08	3.04	2.99	2.95	2.91	2.87	2.83	2.78	2.74	2.70	2.66	2.62	2.57
69.5	3.51	3.68	3.53	3.49	3.45	3.41	3.36	3.32	3.28	3.24	3.20	3.15	3.11	3.07	3.03	2.99	2.94	2.90	2.86	2.82	2.78	2.73	2.69	2.65	2.61
70.0	3.54	3.71	3.57	3.52	3.48	3.44	3.40	3.36	3.31	3.27	3.23	3.19	3.15	3.10	3.06	3.02	2.98	2.94	2.89	2.85	2.81	2.77	2.73	2.68	2.64
70.5	3.58	3.75	3.60	3.56	3.52	3.47	3.43	3.39	3.35	3.31	3.26	3.22	3.18	3.14	3.10	3.05	3.01	2.97	2.93	2.89	2.84	2.80	2.76	2.72	2.68
71.0	3.61	3.78	3.63	3.59	3.55	3.51	3.47	3.42	3.38	3.34	3.30	3.26	3.21	3.17	3.13	3.09	3.05	3.00	2.96	2.92	2.88	2.84	2.79	2.75	2.71
71.5	3.65	3.82	3.67	3.63	3.59	3.54	3.50	3.46	3.42	3.37	3.33	3.29	3.25	3.21	3.16	3.12	3.08	3.04	2.99	2.95	2.91	2.87	2.83	2.79	2.74
72.0	3.68	3.85	3.70	3.66	3.62	3.58	3.53	3.49	3.45	3.41	3.37	3.32	3.28	3.24	3.20	3.16	3.11	3.07	3.03	2.99	2.95	2.90	2.86	2.82	2.78
72.5	3.71	3.88	3.74	3.70	3.65	3.61	3.57	3.53	3.49	3.44	3.40	3.36	3.32	3.28	3.23	3.19	3.15	3.11	3.07	3.02	2.98	2.94	2.90	2.86	2.81
73.0	3.75	3.92	3.77	3.73	3.69	3.65	3.60	3.56	3.52	3.48	3.44	3.39	3.35	3.31	3.27	3.23	3.18	3.14	3.10	3.06	3.02	2.97	2.93	2.89	2.85
73.5	3.78	3.95	3.81	3.76	3.72	3.68	3.64	3.60	3.55	3.51	3.47	3.43	3.39	3.34	3.30	3.26	3.22	3.18	3.13	3.09	3.05	3.01	2.97	2.93	2.88
74.0	3.82	3.99	3.84	3.80	3.76	3.71	3.67	3.63	3.59	3.55	3.50	3.46	3.42	3.38	3.34	3.29	3.25	3.21	3.17	3.13	3.08	3.04	3.00	2.96	2.92
74.5	3.85	4.02	3.87	3.83	3.79	3.75	3.71	3.66	3.62	3.58	3.54	3.50	3.45	3.41	3.37	3.33	3.29	3.24	3.20	3.16	3.12	3.08	3.03	2.99	2.95
75.0	3.89	4.06	3.91	3.87	3.82	3.78	3.74	3.70	3.66	3.61	3.57	3.53	3.49	3.45	3.40	3.36	3.32	3.28	3.24	3.19	3.15	3.11	3.07	3.03	2.98
75.5	3.92	4.09	3.94	3.90	3.86	3.82	3.77	3.73	3.69	3.65	3.61	3.56	3.52	3.48	3.44	3.40	3.35	3.31	3.27	3.23	3.19	3.14	3.10	3.06	3.02
76.0	3.95	4.12	3.98	3.94	3.89	3.85	3.81	3.77	3.73	3.68	3.64	3.60	3.56	3.52	3.47	3.43	3.39	3.35	3.31	3.26	3.22	3.18	3.14	3.10	3.05
76.5	3.99	4.16	4.01	3.97	3.93	3.89	3.84	3.80	3.76	3.72	3.68	3.63	3.59	3.55	3.51	3.47	3.42	3.38	3.34	3.30	3.26	3.21	3.17	3.13	3.09
77.0	4.02	4.19	4.05	4.00	3.96	3.92	3.88	3.84	3.79	3.75	3.71	3.67	3.63	3.58	3.54	3.50	3.46	3.42	3.37	3.33	3.29	3.25	3.21	3.16	3.12

C14823

TABLE 5. PREDICTED FVC FOR FEMALES (HUDSON, ET AL: AM REV RESPIR DIS. 1976, 113, 587.)

AGE / HT	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
52.0	2.45	2.64	2.65	2.61	2.56	2.52	2.47	2.43	2.39	2.34	2.30	2.25	2.21	2.17	2.12	2.08	2.03	1.99	1.95	1.90	1.86	1.81	1.77	1.73	1.68
52.5	2.50	2.68	2.70	2.65	2.61	2.57	2.52	2.48	2.43	2.39	2.35	2.30	2.26	2.21	2.17	2.13	2.08	2.04	1.99	1.95	1.91	1.86	1.82	1.77	1.73
53.0	2.54	2.72	2.74	2.70	2.66	2.61	2.57	2.52	2.48	2.44	2.39	2.35	2.30	2.26	2.22	2.17	2.13	2.08	2.04	2.00	1.95	1.91	1.86	1.82	1.78
53.5	2.58	2.76	2.79	2.75	2.70	2.66	2.62	2.57	2.53	2.48	2.44	2.40	2.35	2.31	2.26	2.22	2.18	2.13	2.09	2.04	2.00	1.96	1.91	1.87	1.82
54.0	2.62	2.81	2.84	2.79	2.75	2.71	2.66	2.62	2.57	2.53	2.49	2.44	2.40	2.35	2.31	2.27	2.22	2.18	2.13	2.09	2.05	2.00	1.96	1.91	1.87
54.5	2.66	2.85	2.89	2.84	2.80	2.75	2.71	2.67	2.62	2.58	2.53	2.49	2.45	2.40	2.36	2.31	2.27	2.23	2.18	2.14	2.09	2.05	2.01	1.96	1.92
55.0	2.71	2.89	2.93	2.89	2.84	2.80	2.76	2.71	2.67	2.62	2.58	2.54	2.49	2.45	2.40	2.36	2.32	2.27	2.23	2.18	2.14	2.10	2.05	2.01	1.96
55.5	2.75	2.93	2.98	2.94	2.89	2.85	2.80	2.76	2.72	2.67	2.63	2.58	2.54	2.50	2.45	2.41	2.36	2.32	2.28	2.23	2.19	2.14	2.10	2.06	2.01
56.0	2.79	2.98	3.03	2.98	2.94	2.89	2.85	2.81	2.76	2.72	2.67	2.63	2.59	2.54	2.50	2.45	2.41	2.37	2.32	2.28	2.23	2.19	2.15	2.10	2.06
56.5	2.83	3.02	3.07	3.03	2.99	2.94	2.90	2.85	2.81	2.77	2.72	2.68	2.63	2.59	2.55	2.50	2.46	2.41	2.37	2.33	2.28	2.24	2.19	2.15	2.11
57.0	2.87	3.06	3.12	3.08	3.03	2.99	2.94	2.90	2.86	2.81	2.77	2.72	2.68	2.64	2.59	2.55	2.50	2.46	2.42	2.37	2.33	2.28	2.24	2.20	2.15
57.5	2.91	3.10	3.17	3.12	3.08	3.04	2.99	2.95	2.90	2.86	2.82	2.77	2.73	2.68	2.64	2.60	2.55	2.51	2.46	2.42	2.38	2.33	2.29	2.24	2.20
58.0	2.96	3.14	3.21	3.17	3.13	3.08	3.04	2.99	2.95	2.91	2.86	2.82	2.77	2.73	2.69	2.64	2.60	2.55	2.51	2.47	2.42	2.38	2.33	2.29	2.25
58.5	3.00	3.18	3.26	3.22	3.17	3.13	3.09	3.04	3.00	2.95	2.91	2.87	2.82	2.78	2.73	2.69	2.65	2.60	2.56	2.51	2.47	2.43	2.38	2.34	2.29
59.0	3.04	3.22	3.31	3.26	3.22	3.18	3.13	3.09	3.04	3.00	2.96	2.91	2.87	2.82	2.78	2.74	2.69	2.65	2.60	2.56	2.52	2.47	2.43	2.38	2.34
59.5	3.08	3.27	3.36	3.31	3.27	3.22	3.18	3.14	3.09	3.05	3.00	2.96	2.92	2.87	2.83	2.78	2.74	2.70	2.65	2.61	2.56	2.52	2.48	2.43	2.39
60.0	3.12	3.31	3.40	3.36	3.31	3.27	3.23	3.18	3.14	3.09	3.05	3.01	2.96	2.92	2.87	2.83	2.79	2.74	2.70	2.65	2.61	2.57	2.52	2.48	2.43
60.5	3.17	3.35	3.45	3.41	3.36	3.32	3.27	3.23	3.19	3.14	3.10	3.05	3.01	2.97	2.92	2.88	2.83	2.79	2.75	2.70	2.66	2.61	2.57	2.53	2.48
61.0	3.21	3.39	3.50	3.45	3.41	3.36	3.32	3.28	3.23	3.19	3.14	3.10	3.06	3.01	2.97	2.92	2.88	2.84	2.79	2.75	2.70	2.66	2.62	2.57	2.53
61.5	3.25	3.43	3.54	3.50	3.46	3.41	3.37	3.32	3.28	3.24	3.19	3.15	3.10	3.06	3.02	2.97	2.93	2.88	2.84	2.80	2.75	2.71	2.66	2.62	2.58
62.0	3.29	3.48	3.59	3.55	3.50	3.46	3.41	3.37	3.33	3.28	3.24	3.19	3.15	3.11	3.06	3.02	2.97	2.93	2.89	2.84	2.80	2.75	2.71	2.67	2.62
62.5	3.33	3.52	3.64	3.59	3.55	3.51	3.46	3.42	3.37	3.33	3.29	3.24	3.20	3.15	3.11	3.07	3.02	2.98	2.93	2.89	2.85	2.80	2.76	2.71	2.67
63.0	3.38	3.56	3.68	3.64	3.60	3.55	3.51	3.46	3.42	3.38	3.33	3.29	3.24	3.20	3.16	3.11	3.07	3.02	2.98	2.94	2.89	2.85	2.80	2.76	2.72
63.5	3.42	3.60	3.73	3.69	3.64	3.60	3.56	3.51	3.47	3.42	3.38	3.34	3.29	3.25	3.20	3.16	3.12	3.07	3.03	2.98	2.94	2.90	2.85	2.81	2.76
64.0	3.46	3.64	3.78	3.73	3.69	3.65	3.60	3.56	3.51	3.47	3.43	3.38	3.34	3.29	3.25	3.21	3.16	3.12	3.07	3.03	2.99	2.94	2.90	2.85	2.81
64.5	3.50	3.69	3.83	3.78	3.74	3.69	3.65	3.61	3.56	3.52	3.47	3.43	3.39	3.34	3.30	3.25	3.21	3.17	3.12	3.08	3.03	2.99	2.95	2.90	2.86
65.0	3.54	3.73	3.87	3.83	3.78	3.74	3.70	3.65	3.61	3.56	3.52	3.48	3.43	3.39	3.34	3.30	3.26	3.21	3.17	3.12	3.08	3.04	2.99	2.95	2.90
65.5	3.59	3.77	3.92	3.88	3.83	3.79	3.74	3.70	3.66	3.61	3.57	3.52	3.48	3.44	3.39	3.35	3.30	3.26	3.22	3.17	3.13	3.08	3.04	3.00	2.95
66.0	3.63	3.81	3.97	3.92	3.88	3.83	3.79	3.75	3.70	3.66	3.61	3.57	3.53	3.48	3.44	3.39	3.35	3.31	3.26	3.22	3.17	3.13	3.09	3.04	3.00
66.5	3.67	3.85	4.01	3.97	3.93	3.88	3.84	3.79	3.75	3.71	3.66	3.62	3.57	3.53	3.49	3.44	3.40	3.35	3.31	3.27	3.22	3.18	3.13	3.09	3.05
67.0	3.71	3.89	4.06	4.02	3.97	3.93	3.88	3.84	3.80	3.75	3.71	3.66	3.62	3.58	3.53	3.49	3.44	3.40	3.36	3.31	3.27	3.22	3.18	3.14	3.09
67.5	3.75	3.94	4.11	4.06	4.02	3.98	3.93	3.89	3.84	3.80	3.76	3.71	3.67	3.62	3.58	3.54	3.49	3.45	3.40	3.36	3.32	3.27	3.23	3.18	3.14
68.0	3.79	3.98	4.15	4.11	4.07	4.02	3.98	3.93	3.89	3.85	3.80	3.76	3.71	3.67	3.62	3.58	3.54	3.49	3.45	3.41	3.36	3.32	3.27	3.23	3.19
68.5	3.84	4.02	4.20	4.16	4.11	4.07	4.03	3.98	3.94	3.89	3.85	3.81	3.76	3.72	3.67	3.63	3.59	3.54	3.50	3.45	3.41	3.37	3.32	3.28	3.23
69.0	3.88	4.06	4.25	4.20	4.16	4.12	4.07	4.03	3.98	3.94	3.90	3.85	3.81	3.76	3.72	3.68	3.63	3.59	3.54	3.50	3.46	3.41	3.37	3.32	3.28
69.5	3.92	4.10	4.30	4.25	4.21	4.16	4.12	4.08	4.03	3.99	3.94	3.90	3.86	3.81	3.77	3.72	3.68	3.64	3.59	3.55	3.50	3.46	3.42	3.37	3.33
70.0	3.96	4.15	4.34	4.30	4.25	4.21	4.17	4.12	4.08	4.03	3.99	3.95	3.90	3.86	3.81	3.77	3.73	3.68	3.64	3.59	3.55	3.51	3.46	3.42	3.37
70.5	4.00	4.19	4.39	4.35	4.30	4.25	4.21	4.17	4.13	4.08	4.04	3.99	3.95	3.91	3.86	3.82	3.77	3.73	3.69	3.64	3.60	3.55	3.51	3.47	3.42
71.0	4.05	4.23	4.44	4.39	4.35	4.30	4.26	4.22	4.17	4.13	4.08	4.04	4.00	3.95	3.91	3.86	3.82	3.78	3.73	3.69	3.64	3.60	3.56	3.51	3.47
71.5	4.09	4.27	4.48	4.44	4.40	4.35	4.31	4.26	4.22	4.18	4.13	4.09	4.04	4.00	3.96	3.91	3.87	3.82	3.78	3.74	3.69	3.65	3.60	3.56	3.52
72.0	4.13	4.31	4.53	4.49	4.44	4.40	4.35	4.31	4.27	4.22	4.18	4.13	4.09	4.05	4.00	3.96	3.91	3.87	3.83	3.78	3.74	3.69	3.65	3.61	3.56
72.5	4.17	4.36	4.58	4.53	4.49	4.45	4.40	4.36	4.31	4.27	4.23	4.18	4.14	4.09	4.05	4.01	3.96	3.92	3.87	3.83	3.79	3.74	3.70	3.65	3.61
73.0	4.21	4.40	4.62	4.58	4.54	4.49	4.45	4.40	4.36	4.32	4.27	4.23	4.18	4.14	4.10	4.05	4.01	3.96	3.92	3.88	3.83	3.79	3.74	3.70	3.66
73.5	4.26	4.44	4.67	4.63	4.58	4.54	4.50	4.45	4.41	4.36	4.32	4.28	4.23	4.19	4.14	4.10	4.06	4.01	3.97	3.92	3.88	3.84	3.79	3.75	3.70
74.0	4.30	4.48	4.72	4.67	4.63	4.59	4.54	4.50	4.45	4.41	4.37	4.32	4.28	4.23	4.19	4.15	4.10	4.06	4.01	3.97	3.93	3.88	3.84	3.79	3.75
74.5	4.34	4.52	4.77	4.72	4.68	4.63	4.59	4.55	4.50	4.46	4.41	4.37	4.33	4.28	4.24	4.19	4.15	4.11	4.06	4.02	3.97	3.93	3.89	3.84	3.80
75.0	4.38	4.57	4.81	4.77	4.72	4.68	4.64	4.59	4.55	4.50	4.46	4.42	4.37	4.33	4.28	4.24	4.20	4.15	4.11	4.06	4.02	3.98	3.93	3.89	3.84
75.5	4.42	4.61	4.86	4.82	4.77	4.73	4.68	4.64	4.60	4.55	4.51	4.46	4.42	4.38	4.33	4.29	4.24	4.20	4.16	4.11	4.07	4.02	3.98	3.94	3.89
76.0	4.47	4.65	4.91	4.86	4.82	4.77	4.73	4.69	4.64	4.60	4.55	4.51	4.47	4.42	4.38	4.33	4.29	4.25	4.20	4.16	4.11	4.07	4.03	3.98	3.94
76.5	4.51	4.69	4.95	4.91	4.87	4.82	4.78	4.73	4.69	4.65	4.60	4.56	4.51	4.47	4.43	4.38	4.34	4.29	4.25	4.21	4.16	4.12	4.07	4.03	3.99
77.0	4.55	4.73	5.00	4.96	4.91	4.87	4.82	4.78	4.74	4.69	4.65	4.60	4.56	4.52	4.47	4.43	4.38	4.34	4.30	4.25	4.21	4.16	4.12	4.08	4.03

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Appendix D

Minimal training guidelines for physicians supervising the medical surveillance of persons who are or have been exposed to asbestos.

1. Introduction

(i) The employer is responsible for the selection and training of medical advisors.

(ii) The physician needs to be familiar with the product, the processes involved in manufacture and the controls present in the workplace which have been designed to prevent unnecessary exposure to asbestos.

(iii) Educational material and attendance at appropriate meetings and courses should be available to the physicians concerned. The information learned should be communicated to the employer and employees to enable them to be fully aware of the nature of the effects of exposure to asbestos.

2. Objectives

(i) To improve health care in industry.

(ii) To arrive at common standards of medical practice.

Union Carbide trial exhibit UC-1293: The Medical Surveillance of Persons Exposed to Asbestos, with Draft OSHA... Published by AsbestosClaims.Law
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(iii) To maintain adequate surveillance of asbestos-exposed employees.

3. Methods

(i) Training should include instruction in pulmonary physiology, toxicology and clinical assessment in relation to occupational health.

(ii) Physicians should be given leave of absence to attend special courses and mini-residencies:

(1) at academic centers providing instruction in occupational health; or

(2) at specialist centers for training in the radiology of asbestos-related disease; or

(3) at both the above.

(iii) Special arrangements must be made for physicians unable to leave their appointments for post-graduate training. Such arrangements should include:

(1) provision of audio-visual training material

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(2) provision of the standard radiographs produced by the International Labor Office (ILO), Geneva [International Classification of Radiographs of Pneumoconioses (Revised 1980)] as a guide to interpreting radiological appearances.

(3) provision of contact with the nearest expert in radiology of the pneumoconioses, pulmonary physiologists versed in the diagnosis of occupational lung disorders and board certified chest physicians, capable of resolving problems or doubtful opinions.

(4) Instructional reading material should be provided for the library of every physican responsible for the medical surveillance of asbestos-exposed persons.

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