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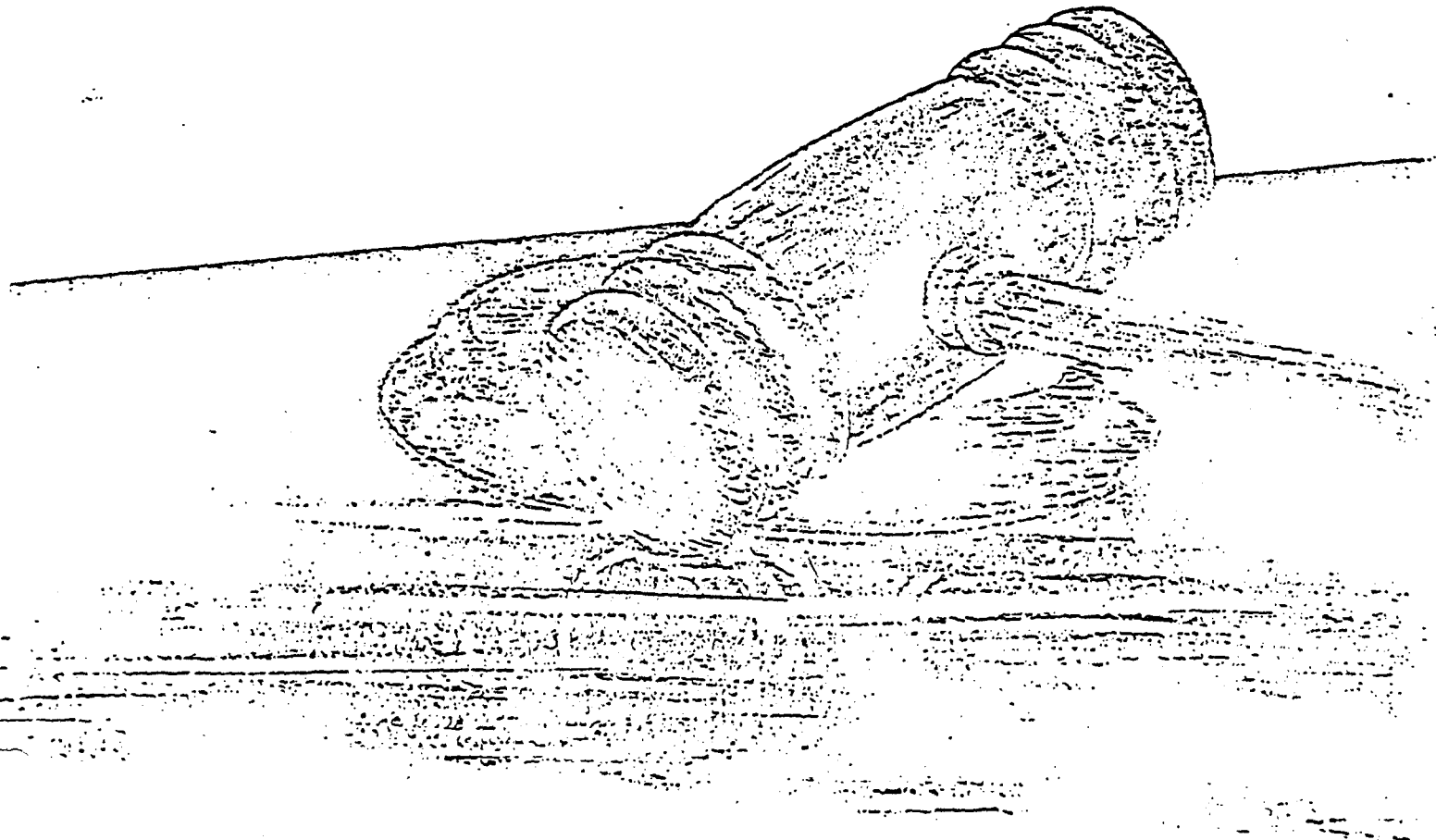
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GUIDE TO THE WORK- RELATEDNESS OF DISEASE

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health



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A GUIDE TO
THE WORK-RELATEDNESS OF DISEASE

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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PREFACE

The goal of the National Institute for Occupational Safety and Health (NIOSH) is to protect the health and safety of working men and women. Within the context of this program are NIOSH efforts that are directed toward the identification of those disease conditions that are causally related to occupation, as necessary prerequisite to their prevention.

This guide is presented primarily as an aid to State agencies and others concerned with occupational disease compensation. The Guide presents one method for assembling and evaluating evidence that may be relevant in determining the work-relatedness of a disease in an individual. Information on five disease-producing agents is presented to illustrate the decision-making process. It should be noted that such information may not be complete and does not necessarily reflect the most recent data regarding health standards and epidemiologic studies.

NIOSH will welcome suggestions for improvement of the Guide based upon experience with its use.

ABSTRACT

This Guide discusses various factors associated with establishing the relationship between disease and occupation. Prepared as an aid to State agencies, physicians, and others concerned with workers' compensation for occupational disease, the publication describes a method for collecting, organizing, and appraising medical, occupational, and other evidence with the aim of determining the probable work-relatedness of a given disease. Illustrative material on five disease-producing agents is included. The Guide also contains a list of occupations with potential exposure to selected agents, and other information that may be useful to those with decision-making responsibility in cases of occupational disease.

ASBESTOS

Introduction

Asbestos is a mineral fiber, and is the name given to about thirty silicate compounds. Of these, only the following 5 are of significance in industry:

Chrysotile (white asbestos)
Amosite
Tremolite

Crocidolite (blue asbestos)
Anthophyllite

Chrysotile accounts for about 97 percent of all the asbestos used in this country.

Asbestos is widespread in the environment because of its extensive use in industry and the home. Over 3,000 products contain asbestos.

Because of this wide usage, it may be difficult at times to determine if a disease arising from asbestos is occupational in origin. For example, the air of some relatively new apartment buildings has been found to contain more asbestos fibers than the maximum recommended levels in industry. The source of the fibers in the apartment buildings is the insulating materials used in the ventilating system.

Exposure to asbestos can produce a lung fibrosis called asbestosis. The onset of asbestosis is usually gradual, developing over a period of 10 to 30 years of exposure to significant concentrations of asbestos. Occasionally, from very massive exposures, it may develop more quickly.

Asbestos is also a cancer producing agent (bronchogenic carcinoma, mesothelioma) and can cause certain specific skin diseases (asbestotic subcutaneous granulomatosis and asbestotic cutaneous verruca). Heavy exposure to dust containing asbestos can cause skin irritation. Epidemiologic studies (experience with groups of people) and animal studies have shown that increased exposure to any of the types of asbestos increases the risk of lung cancer (bronchial carcinoma). This carcinoma appears to be related to the degree of exposure to asbestos, the type of asbestos and cigarette smoking. It is also significant that cigarette smoking in men and women greatly increase the risk of lung cancer in those who are exposed to asbestos. Smoking is a factor that should be considered when determining whether lung cancer is caused, wholly or in part, by an occupational exposure to asbestos.

Mesothelioma, a rare malignant tumor of the membrane which lines the chest cavity and the abdominal cavity, is occurring with increasing frequency in workers with exposure to asbestos. The development of this tumor apparently is not related to the amount of asbestos inhaled and it is found in persons not having asbestosis. Levels of exposure which are within accepted standards for protection against asbestosis, may not

protect against mesothelioma.

An increased incidence of malignancy of the stomach and colon has been reported among insulation workers using asbestos.

Occupations with Potential Exposure to Asbestos

Acoustical Product Makers	Crushers (Asbestos)
Acoustical Product Installers	Fiberizers (Asbestos)
Air filter makers	Fireproofers
Asbestos-cement products makers	Firemen
Asbestos-cement products users	Furnace filter makers
Asbestos-coatings makers	Gasket makers
Asbestos-coatings users	Heat resistant clothing makers
Asbestos-grout makers	Insulation workers
Asbestos-grout users	Inert filter media workers
Asbestos-millboard makers	Ironing board cover makers
Asbestos-millboard users	Laboratory hood installers
Asbestos-mortar makers	Laggers
Asbestos-mortar users	Paint makers
Asbestos millers	Pipe insulators
Asbestos miners	Plastics makers
Asbestos-paper makers	Pump packing makers
Asbestos-paper users	Roofers
Asbestos-plaster makers	Roofing materials makers
Asbestos-plaster users	Rubber compounders
Asbestos sprayers	Shingle makers
Asbestos workers	Ship builders
Asphalt mixers	Ship demolition workers
Automobile repair garage workers	Spinners (Asbestos)
Brake lining makers	Talc miners
Building demolition workers	Talc workers
Carders (asbestos)	Textile flameproofers
Caulking compound makers	Textile workers
Caulking compound users	Undercoaters
Clutch facing makers	Vinyl-asbestos tile makers
Cobbers (asbestos)	Vinyl-asbestos tile installers
Construction workers	Weavers (asbestos)

Medical Evaluation

(Also, See Decision-Making Process)

In addition to the usual medical history, the following should be considered:

1. Any history of diseases of the heart or lung or abnormal tissue growth should be carefully evaluated to determine the relationship between the previous disease and the claimant's present condition.

2. A respiratory questionnaire, a sample of which is shown in Appendix, can be useful in evaluating the extent and importance of respiratory symptoms such as:

- breathlessness
- phlegm (sputum) production
- chest pain
- cough
- wheezing

Asbestosis

Shortness of breath upon exertion is usually the first symptom, frequently accompanied by a dry cough. This symptom develops after several years of progressive pulmonary fibrosis. As asbestosis progresses, the following signs and symptoms are observed:

- cough with production of sputum
- anorexia (loss of appetite)
- secondary respiratory infections that are difficult to control
- rapid breathing
- repetitive end-inspiratory crackles (crackling sounds heard in the lower part of the lungs through stethoscope when employee completes each of a series of inhaled breaths)
- orthopnea (breathing difficulty in a recumbent position)
- cyanosis (change in skin color to bluish, grayish, slate-like or dark purple)
- decrease of chest expansion
- digital clubbing (rounding of the ends, and swelling of the fingers and/or toes)
- sequelae (other resultant diseases) including cor pulmonale (right heart failure), bronchogenic carcinoma (lung cancer), stomach or intestinal cancer, or pleural carcinoma (cancer of the membrane lining the chest)

Fibrosis results in alveolo-capillary block (impaired ability of the lungs to transfer oxygen into the blood). This impairment is often more severe than is indicated by chest x-rays.

Mesothelioma

In cases of mesothelioma, the rare malignancy noted above, there may be a long latent period, as much as 40 years, between initial exposure to asbestos and the development of the tumor.

Mesothelioma of the peritoneum (membrane surrounding the abdominal organs) is usually accompanied by abdominal swelling and pain that is not concentrated in a particular area. Signs and symptoms of this type of tumor (which may be associated with asbestos exposure) include:

- weight loss
- obstruction of the bowel
- excessive accumulation of fluid in the abdominal cavity (ascites) is almost always present

This malignant tumor of the peritoneum may spread to the chest cavity.

With mesothelioma of the pleura, complaints include chest pain and breathlessness. Signs and symptoms of pleural mesothelioma include:

- pleural effusion (accumulation of fluid in the space around the lungs)
- the tumor may grow outward through the chest wall in the form of a lump beneath the skin (subcutaneous lump)
- the tumor may spread to involve bone, lymph glands (nodes) mediastinum (area between the right and left lungs), and pericardium (the sac enclosing the heart). As a result, the supraclavicular nodes may become enlarged, ribs may develop tumors, and obstruction of the superior vena cava (major vein draining the upper portion of the body) may occur.
- in addition, pericardial effusion (fluid in the heart cavity) may occur, causing tamponade.

Laboratory

(See Decision-Making Process)

Additional tests which will assist in arriving at a correct diagnosis are:

Chest X-rays

Findings should be classified according to the ILO/UC 1971 Classification of the Radiographs of the Pneumoconioses. (Appendix B)

Findings for asbestosis vary, but the usual picture shows a density in both lungs, with the lower one-third of the lungs involved. In the affected area there is a "ground glass" appearance.

As asbestosis progresses, more and more of the lung is involved, except the apices (tips of the lungs). The X-rays will show gradual obscuring of the border between the lungs and the diaphragm. It may show shadows from the presence of nodules.

X-ray findings usually will show the following as the asbestosis progresses:

- reduced radiographic volume
- formation of cysts combined with increased size of the heart, dilation (enlargement) of the proximal pulmonary arteries (arteries which lead from the heart to the lungs)

Lung Function Tests

Reduced lung capacities and other lung changes do not differ from those resulting from other forms of lung fibrosis, both occupational and nonoccupational. Therefore, the results of lung function tests alone or chest X-ray findings alone do not lead to diagnosis of asbestosis. Asbestos bodies in lymph nodes indicate exposure, but not necessarily asbestosis.

- Asbestosis causes a reduction in the vital capacity (VC) of the lungs and a reduction in total lung capacity (TLC). These capacities are further reduced as the disease progresses.
- The residual volume (RV) of the lungs will be normal or slightly increased.
- The lungs' diffusing capacity for carbon monoxide (D_L) will be reduced.

Other lung function test results which are found in asbestosis include:

- Increased minute ventilation (amount of air breathed in one minute)
- Reduced oxygenation of the arterial blood (arterial hypoxemia)
- Increased static transpulmonary pressures
- Decreased lung compliance

An exercise test will result in an increased amount of air required during physical effort, decreased oxygen in the blood, leading to cyanosis.

Sputum Examination

Asbestos fibers or bodies may be found in the sputum. These indicate asbestos exposure, but not necessarily asbestosis. Where cancer cells are present in the sputum, and chest X-ray findings are normal, bronchoscopy may be necessary to confirm and locate the lung tumor.

Skin Tests--The following tests should be performed by the physician to exclude possible infectious diseases:

- | | |
|--------------------------|-----------------|
| 1. PPD (tuberculin test) | 3. histoplasmin |
| 2. blastomycin | 4. coccidioidin |

Epidemiological Data

Various epidemiologic studies have demonstrated the relationship between asbestos and lung disease, including mesothelioma, in such trades and occupations as mining, insulation installation, textiles, paint, electrical industries, and many other occupations as a result of the widespread use of this substance.

The available information indicates evidence of a dose-response relationship for asbestos exposure and the risk of asbestosis and/or bronchogenic carcinoma. However, much of this information is epidemiological in nature and there is little correlation between epidemiologic data and environmental exposure data. For this reason and others, including the long latent period for the development of carcinomas, it is difficult to develop a specific dose-response relationship. This should be taken into consideration when referring to the following material:

Enterline has reported an exposure-response relationship between asbestos exposure (evaluated as millions of particles per cubic foot years) and the risk of malignant and nonmalignant respiratory disease. Enterline's data indicates that the risk of respiratory cancer increased from 166.7 (standardized mortality ratio) at minimum exposure to 555.6 at cumulative exposures exceeding 750 million particles per cubic foot years. Enterline's data is summarized in a table by NIOSH².

Murphy³ reported that asbestosis was 11 times more common among pipe coverers in new ship construction than in a control group. The first asbestosis was found after 13 years of exposure to an estimated cumulative dose of about 60 million particles per cubic foot years. After 20 years, asbestosis prevalence was 38%. Murphy reported no asbestosis for men exposed to 60 mppcf years but 20% asbestosis in men exposed to 75-100 mppcf years. Murphy reports atmospheric dust concentrations ranged from 0.8-10.0 mppcf depending on the different operations evaluated. Asbestosis was considered present if the worker had at least three of the following: vascular rales in two or more sites, clubbing of the fingers, vital capacity of less than 80% predicted, roentgenography consistent with moderately advanced or advanced asbestosis, shortness of breath on climbing one flight of stairs.

The Pennsylvania Department of Health⁴ reported a study of asbestos dust concentrations in two plants (one studies from 1930-1967 and the other from 1948-1968). 64 cases of asbestosis were reported. In the two plants, the study indicates that the air concentrations of particulates were generally less than five mppcf and in many cases less than two mppcf.

Epidemiological evidence is also available relating the development of mesothelioma with exposure to asbestos. Selikoff^{5,6} reported 14 deaths

from mesothelioma in 532 asbestos insulation workers from 1943-1968. No deaths from mesothelioma would be expected from the same number of individuals in the general population.

Evidence of Exposure

Historically, there have been two air sampling and analysis methods to determine the quantity of asbestos in the workplace environment. The earlier light field impinger count method allowed only a measure of the overall dust level in the air rather than focusing on the amount of asbestos fibers in the air. The current fiber count method satisfactorily determines the amount of asbestos fibers in the air. It is performed by collecting airborne materials on a membrane filter and then counting the fibers using a phase contrast microscope at a 400 to 450 times magnification ratio (400X-450X).

Asbestos fibers occur in varying lengths and diameters. As of the publication of the guide, the Occupational Safety and Health Act (OSHA) establishes maximum allowable limits for asbestos fibers greater than five micrometers (um) in length. OSHA limits such asbestos fibers to no more than five fibers per cubic centimeter of air (based on an eight hour time-weighted average exposure).

OSHA further requires that no workers be exposed to more than 10 asbestos fibers (greater than five um in length) during any one 15 minute period of time.

For samples collected by the field impinger count method, results may be compared to the pre-1970 limit (TLV) of five million particles per cubic foot of air.

Occupational exposure to asbestos fibers five um in length or greater, at quantities averaging more than five fibers per cubic centimeter of air or frequent exposures to more than 10 such fibers during a 15-minute period of time is evidence of a possible causal relationship between disease and occupation.

Toxicological

(See References 1-6, Appendix A)

Conclusion

The diagnosis of occupational asbestosis is based on meeting the following criteria:

1. Confirmed history of occupational exposure to asbestos.
2. X-ray findings compatible with those indicating asbestosis according to ILO/UC 1971 "Classification of Radiographs of the Pneumoconioses."
3. Pulmonary impairment, particularly a decrease in lung diffusing capacity and an increase in alveolar-arterial oxygen difference.

as demonstrated by lung function tests.

The diagnosis of occupational mesothelioma is based on meeting the following criteria:

1. Confirmed history of occupational exposure to asbestos.
2. Pathological evidence of mesothelioma.

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C. SAMPLE RESPIRATORY QUESTIONNAIRE

Use the actual wording of each question. Put X in the appropriate space after each question. When in doubt, record "NO."

PREAMBLE: I am going to ask you some questions mainly about your chest. I should like you to answer 'YES' or 'NO' whenever possible.

- | | <u>YES</u> | <u>NO</u> | <u>N/A</u> |
|---|------------|-----------|------------|
| 1. Do you usually cough first thing in the morning or on getting up? | _____ | _____ | |
| (Count a cough with first smoke or on first going out of doors. Exclude throat clearing or a single cough.) | | | |
| 2. Do you cough like this on most days for as much as three months each year? | _____ | _____ | _____ |
| 3. Do you cough at work? | _____ | _____ | |
| 4. Do you usually bring up some phlegm from your chest first thing in the morning or on getting up? | _____ | _____ | |
| (Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) | | | |

5. Do you bring up phlegm like this on most days for as much as three months each year?

6. In the past three years, have you had a period of (increased) cough and phlegm lasting 3 weeks or more?

7. Have you had more than one such period?

8. Does your chest ever feel tight or your breathing become difficult?

9. Do you get this apart from colds?

(If YES: specify...(Interviewer to code)

(a) With Exercise

(b) At Work

(c) Any Other Time

If disabled from walking by skeletal or other physical disability put 'X' here.

10. Are you troubled by shortness of breath, when hurrying on the levels or walking up a slight hill?

(If 'NO' omit questions 11 and 12)

11. Do you get short of breath walking with other people of your own age on level ground?

(If 'NO' omit question 12)

12. Do you have to stop for breath when walking
at your own pace on level ground? _____
13. Do you usually have a stuffy nose or
catarrh at the back of your nose in the
winter? _____
14. Do you have this in the summer? _____
(If "NO" to both questions 13 and 14,
go to question 16)
15. Do you have this on most days for as much
as three months each year? _____
16. During the past 3 years have you had any
chest illness which has kept you off work
or from your usual activities for as much
as a week? _____
17. Did you bring up more phlegm than usual
in any of these illnesses? _____
18. Have you had more than one illness with
phlegm like this in the last 3 years? _____

HAVE YOU EVER HAD:

(Give relevant details after each positive answer.)

19. An injury or operation affecting your _____
chest? _____

20. Heart trouble? _____

21. Bronchitis? _____
22. Pneumonia? _____
23. Pleurisy? _____
24. Pulmonary Tuberculosis? _____
25. Bronchial Asthma? _____
26. Eczema? _____
27. Dermatitis? _____
28. Pneumoconiosis? _____
29. Byssinosis? _____
30. Other chest troubles? _____
31. Have you ever smoked? _____

(Record 'NO' if subject has never smoked
as much as one cigarette a day, or 1 oz.
tobacco a month, for as long as one year)

32. Age when stopped _____ years. Was this
in the last month? _____

If 'YES' to 31 and 32, fill in figures
below:

	<u>AMOUNT SMOKED</u>	
	<u>NOW</u>	<u>BEFORE STOPPING</u>
Cigarettes/day (Average including weekends)	_____	_____
Oz. tobacco/week (handrolled)	_____	_____
Cigars/week (large)	_____	_____
Cigars/week (small)	_____	_____

OCCUPATION (1st Interview-Only)

(Record on-lines the-years-in which subject has worked in any of
these industries, e.g., 1960-1963)

	<u>YES</u>	<u>NO</u>
33. Have you ever worked in a dusty job? _____	_____	_____
34. In a coal mine _____	_____	_____
35. In any other mine? _____	_____	_____
36. In a quarry? _____	_____	_____
37. In a foundry? _____	_____	_____
38. In a pottery? _____	_____	_____
39. In a cotton, flax or hemp mill? _____	_____	_____
40. With asbestos? _____	_____	_____

41. In any other dusty job? _____

If 'YES', specify _____

42. Have you been exposed regularly to
irritating gas or chemical fumes? _____

If 'YES', give details of nature and
duration _____

OCCUPATION (Follow-Up only)

43. What is your present job? _____

44. How long have you been doing it? _____

45. What was your previous job in the factory? _____

Taken with minor changes from Operating and Medical Codes of
Practice for Safe Working with Toulene Diisocyanate, Health
Advisory Committee, British Rubber Manufacturers' Association
Ltd.