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THE WESTERN STATES
ASBESTOS HEALTH PLAN

OCCUPATIONAL HEALTH PROGRAM

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WESTERN STATES
CONFERENCE
OF
ASBESTOS
WORKERS

ASSOCIATED
INSULATION
CONTRACTORS
OF THE
WESTERN STATES

OCTOBER 31, 1968

OCCUPATIONAL HEALTH PROGRAM
FOR
THE WESTERN STATES ASBESTOS HEALTH PLAN

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W. Clark Cooper, M.D.
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Trustees of the Western States Asbestos Health Plan, meeting in Seattle, Washington, on October 31, 1968, approved this program and entered into an agreement with Dr. Tabershaw for its implementation.

The Trustees, meeting in San Francisco on March 10, 1969, authorized that copies be made available for general distribution.

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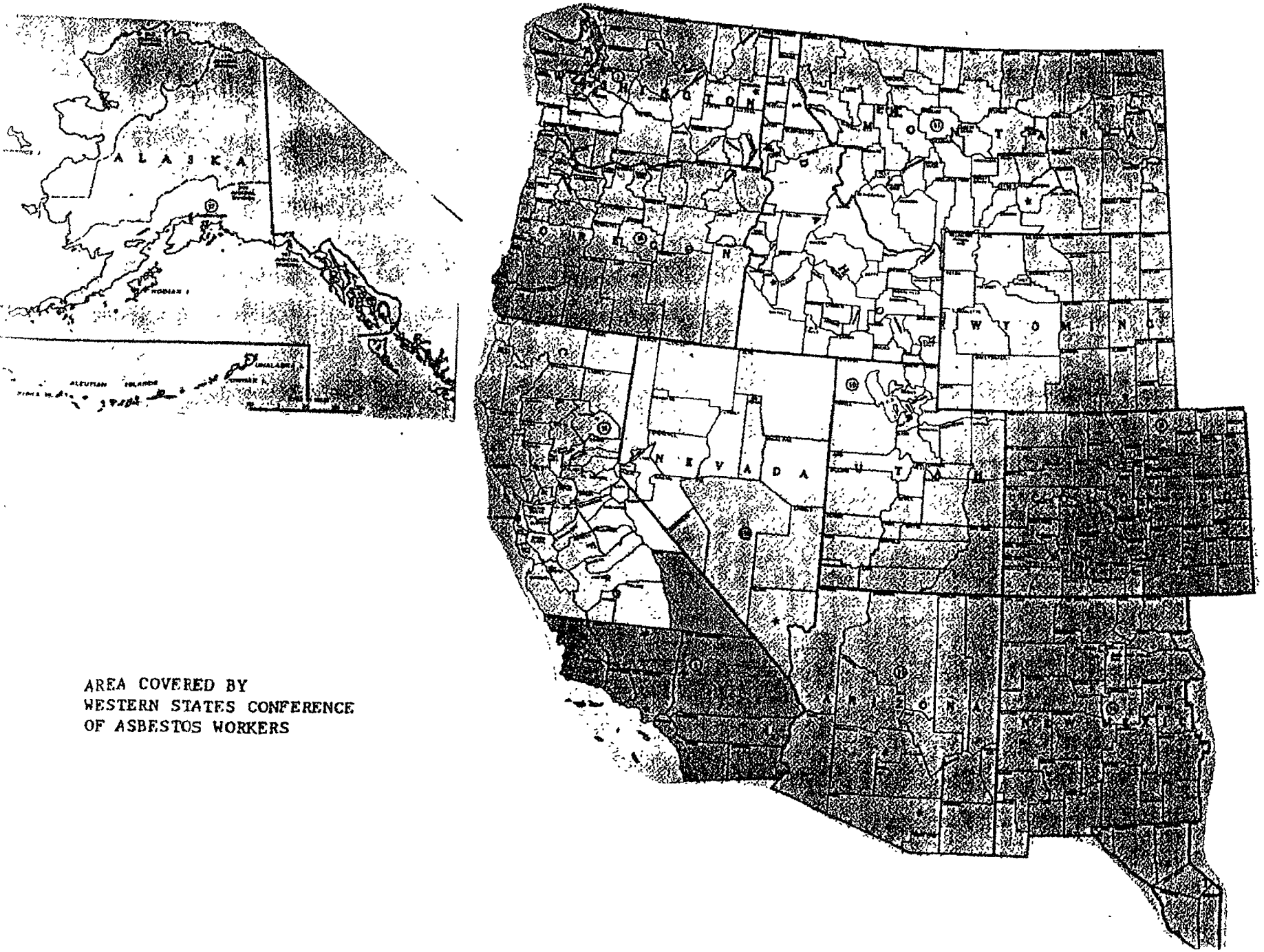
OCCUPATIONAL HEALTH PROGRAM
FOR
THE WESTERN STATES ASBESTOS HEALTH PLAN



AREA COVERED BY
WESTERN STATES CONFERENCE
OF ASBESTOS WORKERS

OCCUPATIONAL HEALTH PROGRAM

for

Asbestos Workers and Insulating Contractors
of the Western States

Irving R. Tabershaw, M.D., W. Clark Cooper, M.D.,
and
J. LeRoy Balzer, M.S.

October 31, 1968

INTRODUCTION

The establishment in 1966 of a supplemental Health and Welfare Fund for Occupational Health and Research by the Associated Insulation Contractors of the Western States and the Western States Conference of Asbestos Workers has made it possible to begin a coordinated program to prevent occupational disease in the insulating trade.

The need for such a program has been increasingly apparent. Insulating workers are subject to a number of specific hazards in their trade, the major ones arising from inhalable dusts in the fabrication, application, finishing, and tearing out of various insulating materials. Knowledge has been steadily accumulated as to methods of reducing exposures to dusts and to detect disease in men already affected. Work in the trade is stable; but frequent changes in work site and jobs, multiple employers, and a widely scattered work force make conventional medical surveillance and industrial hygiene difficult to apply.

A coordinated program is timely. All insulating workers in the area receive medical care through health and welfare plans jointly supported by labor and management. The increasing age of the work force and rising costs of medical care are producing inevitable strains upon health, welfare and pension funds. At the same time, available knowledge on the prevention, diagnosis, and treatment of asbestos-related disease is not being applied. Leadership in both employer and labor groups is concerned not only about the personal effects of preventable illness but also about the ultimate effects on industry. They are therefore seeking effective and practical means of developing and applying modern occupational health practices under the particular conditions of their trade.

In the development of the present proposal, we have (1) reviewed all current health and welfare plans in the Western States, with emphasis upon preventive medicine and industrial hygiene; (2) considered the basic components of medical and environmental surveillance; (3) made specific recommendations upon such medical and environmental programs; and (4) reviewed the suitability and availability of local medical and environmental health resources, with specific recommendations where appropriate.

Local Unions in Area

In Table II are listed the locals of the International Association of Heat and Frost Insulators and Asbestos Workers within the area covered by the Western Conference.

Members of the Associated Insulation Contractors of the Western States do not negotiate directly with all of the unions in the Western Conference. Contractors in Colorado, for example, are in the Midwest Association.

TABLE II

Local Asbestos Workers' Unions in Western States

Local Number	Headquarters	No. of Men	Health & Welfare Contribution	Periodic X-ray	Other Locals in Same H & W Plan
#5	Los Angeles, Calif.	522	0.21¢/hr.	yes	69,73,76,135
#7	Seattle, Washington	134	20¢	no	82,97
#16	San Francisco, Calif.	427	30¢	yes	
#20*	Long Beach, Calif.	---	--	---	
#28	Denver, Colorado	152	16¢	no	
#29*	Hunters Point, Calif.	---	--	---	
#36	Portland, Oregon	144	25¢	no	
#62*	Bremerton, Washington	---	--	---	
#69	Salt Lake City, Utah	94	21¢	yes	73,76,135
#70*	Mare Island, Calif.	---	--	---	
#73	Phoenix, Arizona	93	21¢	yes	5,69,76,135
#76	Albuquerque, N.M.	106	21¢	yes	5,69,73,135
#82	Spokane, Washington	66	20¢	no	7,97
#97	Anchorage, Alaska	78	20¢	no	7,82
#135	Las Vegas, Nevada	46	21¢	yes	5,69,73,76

*Starred locals are in U.S. Naval Shipyards which were not included in the present review.

(2) Seattle, Washington. The Insulation and Asbestos Workers Welfare Trust of Seattle provides life insurance benefits for accidental death and dismemberment, and loss of time for non-occupational disease, medical care and hospital expense benefits to members and/or dependents of local 7 (Seattle and Tacoma), local 82 (Spokane and Billings) and local 97 (Anchorage). Occupational diseases are excluded from benefits if covered by workmen's compensation. Diagnostic check-up examinations not incident to or necessary for the diagnosis of a sickness or accidental injury are expressly excluded, if paid out of insurance. The monthly contribution is 20¢. The insurance carrier is New York Life Insurance Company.

(3) San Francisco, California. The Health and Welfare Plan of local 16 has been in operation since 1951 and now provides benefits for about 440 active and 30 retired members. Medical care, hospital benefits, and lost-time benefits are provided through Blue Cross; and life insurance coverage is by Standard Insurance Company of Portland, Oregon. The program is supported by a 30¢ per hour contribution. Since 1957, the health and welfare fund has provided annual chest films on a voluntary basis to all members, paying at first $10, now $12, to any of several designated radiologists for the service ($16.50 if two films are taken). This is separate from the insurance program, with chest film fees being billed directly to the Administrator of the Health and Welfare Fund, who also receives the films and interpretations. During the first year of the program, pulmonary function tests were performed on about 166 men; these were discontinued because of expense. Over a period of 10 years, nearly 2000 films have been taken in 390 men and have provided excellent serial evidence of changes. Expansion of the program to include annual screening examinations is under consideration.

(4) Denver, Colorado. Local 28 with 156 members has had a health and welfare program since about 1952. It is financed by a contribution of 16¢ an hour, with California Western Life Insurance Company as the insurance carrier. It is a cash indemnity program and does not permit periodic examinations in absence of illness. There have been films taken on a voluntary basis by the local tuberculosis program, but union officials do not know the extent of participation.

(5) Portland, Oregon. The Health and Welfare Plan of local 36 provides hospital, medical and surgical benefits through a choice either of direct benefits from the Kaiser Foundation or cash benefits through International Health and Life Insurance Co. of Portland. Life, accidental death and dismemberment, weekly income, dental benefits and major medical coverage under Kaiser Foundation are underwritten by Bankers Life Company of Des Moines, Iowa. The foregoing are paid for by a 25¢/hour contribution. Laboratory or other expenses involved in periodic examinations are provided under the Kaiser plan but not under the IHA coverage which pays only for necessary x-ray and laboratory procedures incident to the diagnosis or treatment of non-occupational injuries or illness. Dental coverage is for 50% of covered charges in excess of a $15 per annum deductible.

Medical Surveillance. All members are protected against routine and major medical expenses for themselves and their dependents with variations in completeness. It is not the purpose of this report to compare or evaluate medical coverage as such. There is in all locals a consciousness of the need for improved preventive programs. These have been difficult to provide in the context of existing insurance programs and in the absence of any one employer having a large enough proportion of the work force to provide occupational health services.

Periodic chest films, although highly desirable, are not enough in themselves to establish physical status of the worker. Their value is further reduced when x-rays are taken by many different radiologists using different criteria, unrelated to clinical histories, working experience, and knowledge of the insulators' environment. Private physicians see too few men with common working experience to deal consistently with their problems arising out of asbestos exposure.

WORKMEN'S COMPENSATION

Although a separate study would be required to cover workmen's compensation provisions within the 13 States of the Western Conference, information supplied in Table IV shows the important variations in the 14 jurisdictions involved (thirteen States and United States Government). Equally important are the interpretations applied within the various jurisdictions. There are differences in benefits for medical care, temporary total disability, permanent partial disability, permanent total disability, and death, provisions for waiver of compensation, subsequent injury funds (in all jurisdictions except Nevada), provisions for extraterritoriality, allocation of costs to last employer or prorating over all employers considered to be contributory to disease.

The U.S. Department of Labor last year financed a study of the problems of compensation in berylliosis and asbestos-related disease. This study, by the firm of Woodward and Fondiller in New York City, has not yet been released.

RECOMMENDED PROGRAM

The needs of the insulating industry and its workers can best be met by a coordinated occupational health program responsive to both management and labor through the trustees of the participating health and welfare plans. In such a program, the Medical Advisor of the Occupational Health Plan of the Western States, in conformity with guidelines approved by the trustees, would coordinate and supervise medical and industrial hygiene activities as follows:

I. Medical Program

A. Negotiate with appropriate clinics or physicians in each major area to perform periodic examinations on members.

B. Establish content of such examinations.

C. Establish frequency of such examinations.

D. Maintain central file of medical abstracts on members.

E. Maintain central file of duplicate chest films on members.

F. Periodically provide the trustees, contractors and union members with statistical evaluation of physical health status of membership, without revealing individual company or member's name.

G. Provide medical information on asbestos-related diseases and other occupational health problems to participating clinics and physicians, personal physicians, radiologists, and pathologists, with particular emphasis on diagnostic criteria and on relative hazard or safety of work environment.

H. Work directly with local radiologists and pathologists to improve differential diagnosis of asbestos-related diseases.

I. Advise trustees upon workmen's compensation aspects of asbestosis and other asbestos-related diseases.

J. Provide health educational material for distribution to contractors, local unions, and members.

K. Maintain close liaison with members of the medical profession interested in and responsible for the health of the insulator.

L. Keep informed on worldwide research as it pertains to the detection, prevention and treatment of medical problems important to insulating workers, and translate this information into appropriate action.

II. Industrial Hygiene Program

A. Develop manuals of hygienic practice, with the help of the organized health and safety committees in each area, for consideration by trustees and by local union leaders and contractors.

TABLE V

Distribution of Asbestos Workers in Five
Major Locals Based on Years Since Entering Trade

Local	10 or less	10-20	Over 20	Total
#5	123 (23%)	220 (42%)	183 (35%)	526 (100%)
#7	25 (16%)	69 (45%)	60 (39%)	154 (100%)
#16	134 (31%)	115 (27%)	178 (42%)	427 (100%)
#36	29 (22%)	30 (23%)	74 (56%)	133 (100%)
#82	29 (17%)	57 (33%)	85 (50%)	171 (100%)
	340 (24%)	491 (35%)	580 (41%)	1411 (100%)

Site and Costs. It is important that the examinations be done by one physician or clinic in each major area, using forms prescribed by the Occupational Health Plan. Discussions with representative clinics in the areas have indicated that an examination as outlined would cost about $50, as of mid-1968. This would involve individual negotiation and perhaps local modifications of some parts of the examination. Scheduling examinations every two or three years in some members would release funds for special studies indicated for others. Health and welfare funds should appropriate funds equivalent to $50 per member to cover the examination program.

Supervision. The Medical Advisor would supply participating clinics with specific information on the currently accepted criteria for the diagnosis of asbestosis and systems for classification of chest roentgenograms. Representative films for radiologists to review would be circulated to apprise them of diagnostic criteria.

Similarly, pathologists in each area would be kept advised of current information on the pathologic diagnosis of asbestosis with the aim of discouraging either over- or under-diagnosis.

Medical Records. A duplicate chest film and a summary of each member's medical record would be kept on file in the office of the Medical Advisor, with the consent of the man examined. The medical staff would be available for consultation (or to suggest appropriate consultation) in difficult diagnostic situations.

B. Review and evaluation of periodic reports on the extent of participation by union membership, and statistical data on findings (without identification of individuals by name).

C. Providing and approving specific suggestions for industrial hygiene practices.

D. Suggesting contacts with local pathologists, radiologists, industrial hygienists, as needed.

III. Contractors.

A. Associated Insulation Contractors of the Western States:

1. Would be regarded as source of information on general problems and needs of the insulating contractor.

2. Would periodically receive information on preventive medical and industrial hygiene efforts.

3. Would receive scientific and educational material on the control of hazards in the insulating trade.

4. Would be apprised in advance of possible recommendations for industrial hygiene that might prove unduly expensive or burdensome.

5. Would be kept advised on compensation legislation.

B. Individual contractors, in addition:

1. Would receive interpretation of environmental findings made by local industrial hygienists.

2. When feasible would be given assistance in industrial hygiene surveys, with specific recommendations.

3. Would receive detailed environmental data relating to their individual work sites (names of contractors, or identifiable jobs would not be made public without written consent of the contractor involved).

IV. Insulating Workers.

A. International Union - There would be full cooperation with educational and research efforts of the international union, subject only to restrictions on confidentiality of information.

B. Western Conference

1. Would receive periodic reports on the status of preventive medical efforts and industrial hygiene efforts.

2. Would receive scientific and educational material on the control of hazards in the trade.

3. Would be kept advised on trends in compensation.

SUMMARY

After review of (1) the medical and industrial hygiene needs of the insulating industry in the Western states, (2) the distribution of insulators and contractors, (3) the current health and welfare plans and environmental control efforts, and (4) available medical and environmental resources, a regional occupational health program is suggested, with the objective of improving and coordinating efforts to control occupational disease and thereby lessen the human and economic effects of preventable illness in the insulating trade:

I. A permanent Medical Advisor should be appointed to work with the Western Conference of Insulating Workers and the Associated Insulating Contractors of the Western States, to develop and carry out medical policies.

II. The Medical Advisor would be responsible to the Trustees of the Western States Occupational Health Plan and would work with trustees of local health and welfare plans in the improvement and implementation of preventive health activities.

III. The asbestos workers and contractors would support, through local health and welfare programs or special assessment, periodic physical examinations of all members, with content and frequency based upon recommendations of the Medical Advisor.

IV. Such examinations should be performed in each local area by a clinic or physician chosen by the local health and welfare plan with the advice of the Medical Advisor.

V. Estimated cost of initial and periodic examination is $50 per man per annum (as of mid-1968).

VI. Abstracts of periodic examinations and duplicate chest films would be sent to the Medical Advisor's central file.

VII. The Medical Advisor and his staff would prepare, for local distribution, health education material.

VIII. Each local area would be urged to form a health and safety committee, with labor and management representatives, to supervise local environmental controls.

Evaluation and control of asbestos exposures in the insulating trade

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It has been recognized for a number of years that insulating workers have an increased risk of asbestosis (Leathart and Sanderson, 1953; Marr, 1964; Selikoff et al., 1965; Ahlman, 1966; Keane and Levon, 1966; Ferris, 1967; Klainfeld et al., 1967; and others) and also that they exhibit a higher than expected incidence of lung cancer and other malignancies (e.g., Selikoff, 1964, and Dunn and Weir, 1965). During the past three years, we have had an opportunity to study intensively both the health status and the work practices and environmental exposures of men engaged in the insulating trade in the San Francisco area.

Medical findings will be reported subsequently in greater detail. In the present report, pertinent data will be summarized to verify the magnitude of the problem and to indicate the probability of such epidemiologic studies answering current major questions relevant to asbestos as a health hazard. We will then turn to the practical problems of describing environmental conditions in the trade and appropriate measures to correct them.

Studies Directed Toward the Insulating Workers

Although information is being collected on more than 1,800 members of the International Association of Heat and Frost Insulators and Asbestos Workers who work in California, Washington, Oregon, and portions of Nevada, Arizona and Montana, the present report will be limited to those in San Francisco and adjacent areas. Local 16 of the union, whose official territory this is, has approximately 400 active members (See map). Its jurisdiction, however, does not cover shipyards operated by the U.S. Navy where there are small local unions but where union membership is not obligatory. The latter employ about 110 insulators in the San Francisco area.

Local 16 was organized in 1911. Like other local unions in the asbestos trade, it has been characterized by stability, excellent pay, pride in craftsmanship, and a strong father-to-son tradition. There has been a liberal pension plan since 1956 as well as a health and welfare program which provides comprehensive medical care by physicians and hospitals chosen by the individual members. Both these programs are jointly sponsored and controlled by union and management.

The local is the collective bargaining unit for insulating workers employed by private industry within its jurisdiction. Members may work for any one of the seven major insulating contractors in the area, or may be assigned by the union for work by other contractors as needed. Thus, one man usually works for many employers over a period of years and union records provide the only reference point for a study that has continuity.

Selection of Group for Study

Information was obtained from union records on all men who were members of the local at any time during the period January 1, 1946, through December 31, 1965. Information on deaths, lapses, withdrawals, retirements, transfers, new members, returns to activity and transfers in or out were collected and used to develop a picture of the work force available for study. There were 161 active insulators as of January 1, 1946; 433 entered during the period until 12/31/65, while 214 left the population for various reasons. Thus, 594 individuals were active members at some time or another during the 20-year period, with active membership ranging from 161 in 1946 to 380 in 1966 (Table 1).

Table 1:	Active Members as of January 1, 1946	161
	Entered to December 31, 1965	433
	Total in Population	594
	Less Those Who Left	214
	Active Members as of December 31, 1965	380

Chart 1

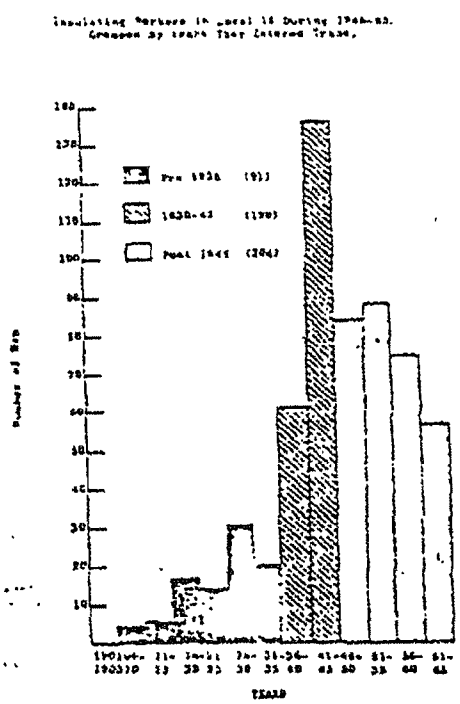


Chart 1 summarizes the time of entering the insulating trade of the 594 men available for study. Only 91 (15 %) started before 1936; so this is the maximum number who could possibly have reached 30 years of observation by 1966. Actually, only 72 individuals with this much exposure were observed. The influx of craftsmen during World War II shipbuilding raised new members to the point that a total of 290, or 49 %, had joined prior to 1946. Thus, nearly one-half could have had 20 or more years of observation by 1966 and 250 of those under observation had passed 20 years since joining the trade. These figures are important in interpreting current findings, particularly with respect to malignancies with long latent periods.

All men with 30 years since joining the trade have worked in the shipyards, the majority having worked there for 5 or more years. Of those with over 20 years in the trade, less than 1 % have never worked in the shipyards. Only when one comes to men who have joined the trade since 1945 do we encounter significant numbers with no shipyard experience.

Evidences of Asbestosis in the Group

There has been a program of voluntary annual chest roentgenograms for all active and retired members since 1957. Films have been taken by any one of several radiologists selected by the Administrator of the Health and Welfare Plan who kept films and interpretations in a central file.

Approximately 1,500 films, taken over a 10-year period, have been reinterpreted, without prior knowledge of work histories, symptoms, or other information. Films with definite or doubtful changes have been independently reviewed by a radiologic consultant who is participating in the UICC-USPHS asbestosis classification project.

For purposes of the present report, negative films were those with no evidence of increased linear or nodular shadows, nor thickened, distorted, or calcified pleura or pericardium. Definite changes consistent with asbestosis included increased linear markings or definite evidence of thickened, distorted, or calcified pleura. Where findings were equivocal including minor pleural changes such as obscured costophrenic angles or questionable parietal thickening, changes were called doubtful.

Excluding all men who died or were lost from the union by transfer or leaving the trade prior to institution of the x-ray program in 1958, there were 480 eligible for films. Of these, 386 took advantage of the opportunity to the extent of having had at least one film. Table 2 illustrates the participation and distribution of those with definite roentgenographic changes, grouped by period of entering trade.

Pleural changes predominated over parenchymal. Including individuals in whom there was evidence for both types of change, 41, or 44 %, had definite parenchymal and 79, or 85 %, had definite pleural abnormalities.

Table 21

Period of Entering Trade	Number Available for Films	Number Having Film(s)	Number with Definite Changes Consistent with Asbestosis Number	%
1906-10	0	0	0	----
1911-15	2	2	2	100%
1916-20	8	5	5	100%
1921-25	7	3	2	67%
1926-30	19	13	8	62%
1931-35	17	13	6	46%
1936-40	49	41	17	41%
1941-45	117	101	33	33%
1946-50	61	47	12	26%
1951-55	69	57	5	9%
1956-60	74	55	2	4%
1961-65	57	49	1	2%
Total	480	386	93	24%

Calcified pleural plaques were demonstrable in 17 individuals, all of whom had been in the trade for 20 years or more. Nine of the 36 individuals examined who had joined the trade prior to 1936 showed definite calcification. As will be pointed out in analyses of mortality, four deaths from cor pulmonale associated with pulmonary fibrosis were reported over the 20-year period from 1946 to 1965.

Mortality Analysis

There have been 72 known deaths in the group of 594 men during the period 1946 - 1965. Death certificates have been obtained for 64. Table 3 summarizes current information on causes of death for the entire group and for the 250 individuals in whom 20 years or more had elapsed since their joining the trade, either at the establishment of the 1946 cohort or subsequent to that date. All of the 14 deaths from lung cancer occurred in those with 20 years or more since joining the trade. Expected rates were based on California mortality rates for white males, the 1949-50-51 rates being applied for the years 1946 - 55, and 1959-60-61 rates for the years 1956 through 1965. Observed lung cancer deaths were 7.87 times expected. Two of the deaths from tumors of the respiratory tract were due to pleural mesothelioma. No peritoneal mesothelioma have been reported. Two malignancies of the gastro-intestinal tract (one of stomach and one of colon) have occurred. Four deaths from cor pulmonale and pulmonary fibrosis were included in the cardiovascular renal category in men with 45, 41, 27, and 21 years in the trade respectively.

Table 3:

Analysis of Deaths in Study Group
(January 1, 1946 through December 31, 1965)

Cause of Death	Total Population of 594	In 250 Men with Over 20 Years in Trade	
	Observed	Observed	Expected
Malignant Neoplasms (140-205)	18	16	2.54
Digestive system (150-159)	2	1	
Respiratory system (160-164)	14+	14+	1.78
Other & Unspecified	2	1	
Major Cardiovascular Renal Disease (330-334)	30++	18++	19.09
Violent Deaths (800-889)	11	6	
All other causes	5	4	
Not Known	8	5	
	72	49	35.13

* International Classification of Diseases, 7th Edition, WHO, Geneva, 1957.

Smoking histories are inadequate on many of the early deaths; and meaningful analysis related to this will be possible only with prospective observations. The possibility of useful data is enhanced by the relatively low smoking rate for those currently working. In the half of the current population so far interviewed on this:

Table 4:	Never Smoked Cigarettes	16 %
	Stopped Smoking (at least one year)	36 %
	Currently Smoke Cigarettes	48 %

Whether this is the result of active campaigns against cigarette smoking in this trade, we do not know. If the pattern persists, prospective studies on the interrelations between smoking and malignancies should be of great interest during the next decade.

The foregoing data confirm that insulating workers in San Francisco resemble similar workers in New York and New Jersey and in the United Kingdom in their risk of both asbestosis and lung cancer. What are the prospects of better defining etiologic factors and reducing the risk through environmental studies?

Environmental Studies

General. The insulating worker, or lagger, handles a variety of insulating materials, described below, in jobs that range from commercial and major industrial construction to marine construction and repair. Most insulators are trained and qualified in all phases of their craft and for all materials. Some specialize, but over the years a great variety of jobs is the rule.

We have found it convenient to classify jobs under two major headings: (1) light and heavy industrial construction, which includes covering pipes and ducts in office and factory construction as well as applications of insulating materials to boilers, cracking towers and steam turbines; and (2) marine construction and repair, which involves application of insulating materials to pipes, ducts and boilers in ships, but because of the more rigid specification of materials and their use in predominantly confined spaces and special difficulties in ventilation deserves to be regarded separately.

The insulator's job when working with asbestos containing materials can be divided into 6 general operations: (1) the prefabrication of materials (10 % of his time), in which molded-pipe covering or blocks are cut and shaped to fit, using either hand or power tools. (2) Application (about 40 % of his time) includes fitting, hammering into place, carving, and/or attaching materials by wire or glue. (3) Finishing (30 % of his time) where insulating materials are coated with asbestos containing cement, resins, asbestos, or cotton cloth, or petroleum-based sealers. (4) Tearing out (10 % of his time) where old insulation is removed or unusable materials are taken off prior to reinsulation. (5) Mixing (5 % of his time) in which asbestos fibers, fibrous glass, mineral wool and cements are mixed in various combinations in buckets or troughs or in automatic mixing machines. (6) General work occupies the remaining 5 % of his time and includes cleaning up of old insulation, transporting materials and moving equipment. The foregoing are averages based on timing many workers during many jobs using asbestos containing materials. Obviously, they vary from situation to situation; new construction for example would not involve tearing out. At present, less than half the lagger's time is spent with work involving the use of asbestos materials; our current estimate is 45 %.

Table 5: The Insulator's Job

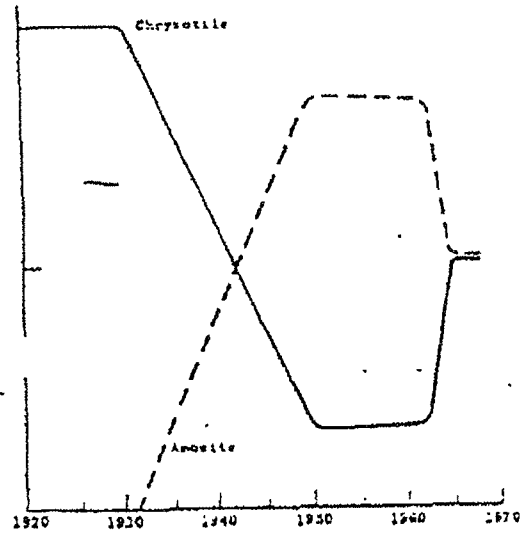
Prefabrication	10 %
Application	40 %
Finishing	30 %
Tearing Out or Replacing Work	10 %

Insulation Materials Used

Asbestos containing insulation materials were introduced into California in the early 1920's, with Canadian chrysotile being used in most products. After the United States Navy used amosite asbestos in the mid-1930's, amosite gradually became the predominant type of asbestos used. It was used both to make amosite blankets and in combination with chrysotile in the manufacture of molded insulation materials (Magnesia and Asbestos). Marine construction and repair created the major demand for this type of insulation during the early 1940's. The use of amosite as the predominant asbestos fiber used continued until soon after 1960 when chrysotile was reintroduced into some molded products. (Chart 2). The use of pure amosite blankets has now nearly ceased. Today, molded insulation materials, which contain 10 - 15 % by weight of asbestos, may have pure chrysotile, pure amosite, or a mixture of the two. The 85 - 90 % is usually calcium silicate, made by mixing amorphous diatomaceous earth with lime and curing with heat. This heating is not sufficient to convert the diatomaceous earth to cristobalite. Crocidolite and anthophyllite are not used in insulating materials in our area.

Chart 2

Relative Use of Chrysotile and Amosite in Insulation Products in the Western United States.



Only about 40 % of the insulating materials now being used are asbestos containing; fibrous glass is widely used, accounting for 45 to 50 % of insulating material applied in San Francisco. The glass most widely used has a fiber diameter greater than 4 microns, but some speciality materials are in the 1 to 2 micron range.

Other materials, which occupy about 10 % of the average insulator's time, include the use of foam glass, cork, rubber, polystyrene and polyurethanes. He also has potential dermatologic and inhalation problems associated with solvents, adhesives, and coating materials.

Environmental Surveys

The dust exposures associated with various phases of the trade were appraised using samples collected by midget impinger and by membrane filter. For the midget impinger counts, methods used were those described in Public Health Service Bulletin No. 217, with 95 % ethyl alcohol as the sampling medium. Sampling times ranged from 10 minutes to 30 minutes representing a maximum sample volume of 3 cubic feet.

Millipore type AA filters for the stated pore size 0,8 micron were used in filter holders, 37 millimeters in diameter with an approximate surface area of 850 square millimeters. These were used with either Casella or MSA battery operated personal samplers, with sampling rates of 1,8 - 2,2 liters per minute. The personal samplers were worn by insulators, while at work, over periods ranging from 30 minutes to 2 hours. Fibers were counted by a modified technique of the USPHS, in which a segment was cut from the filter and placed face up over a drop of 50 % dimethyl phthalate and 50 % diethyl oxylate, and a cover slip applied. The counting field was defined by a graticule using phase contrast illumination with a 4 millimeter (40x phase contrast objective). Fibers defined as particles having a 3:1 or greater length to width ratio were counted and placed in the following categories: less than 3,5 microns in diameter and less than 5 microns in length; less than 3,5 microns in diameter and more than 5 microns in length; more than 3,5 microns in diameter and less than 5 microns in length; and more than 3,5 microns in diameter and more than 5 microns in length. The 3,5 micron

Dust Counts

A total of 197 midget impinger and 10[illegible] membrane filter samples collected in breathing zones while asbestos containing materials were in use are summarized in Tables 6 and 7.

Table 6:

Midget Impinger Dust Concentrations by Job Classification

Job Classifications	Light and Heavy Industrial			Marine Construction and Repair		
	Number of Samples	mppcf		Number of Samples	mppcf	
		Mean	Range		Mean	Range
Prefabrication	21	4.1	0.8-14.0	14	3.2	1.4-28.8
Application	24	2.4	0.4-7.5	19	3.4	1.6-5.9
Mixing	17	4.4	0.9-9.8	15	8.3	1.0-29.0
Finishing	21	1.4	0.2-3.9	20	2.6	0.1-6.2
Tearing Out	17	4.5	1.0-8.6	15	9.1	4.8-23.0
General	24	0.77	0.2-1.8	1[illegible]	1.2	0.5-1.8

Table 7:

MEMBRANE FILTER FIBER CONCENTRATIONS BY JOB CLASSIFICATION

Job Classifications	Light and Heavy Industrial				Marine Construction and Repair			
	Number of Samples	Fibers/cc Mean		Range	Number of Samples	Fibers/cc Mean		Range
		All Lengths	Length > 5μ			All Lengths	Length > 5μ	
Prefabrication	23	10.1	6.6	1.6-19.4	7	30.4	23.0	3.5-100
Application	16	3.1	2.0	0.2-18.3	23	6.2	4.2	0.2-47
Mixing	17	4.7	3.1	0.1-19.4	19	21.2	16.2	0.7-120
Finishing	19	0.9	0.6	0.1-6.3	18	0.8	0.4	0.1-1.3
Tearing Out	8	12.8	8.4	1.2-48.3	16	31.3	20.3	1.4-126
General	16	1.4	1.0	0-14.0	19	0.3	0.2	0-2.9

Variations in materials, jobs, individual's work habits, other construction activities nearby, temperatures, humidity, air movement, complicated the strategy for environmental appraisal. Samples were in most situations deliberately taken under conditions where the highest dust concentrations representative of a particular job were being developed. Midget impinger samples were taken during the course of the collection of the membrane filter sample for the same man and operation. Comparison of this data did not yield useful correlations between the counts obtained by midget impinger and membrane filter.

It is of interest that time-weighted averages were not unusually high and that current TLV recommendations in the United States for asbestos containing dust (5 million particles per cubic foot) would not have been exceeded, even for a man working 100 % of his time with asbestos. The fact that most men work less than half of their time with this material would be an added safety factor. Figures 3 and 4.

Figure 3

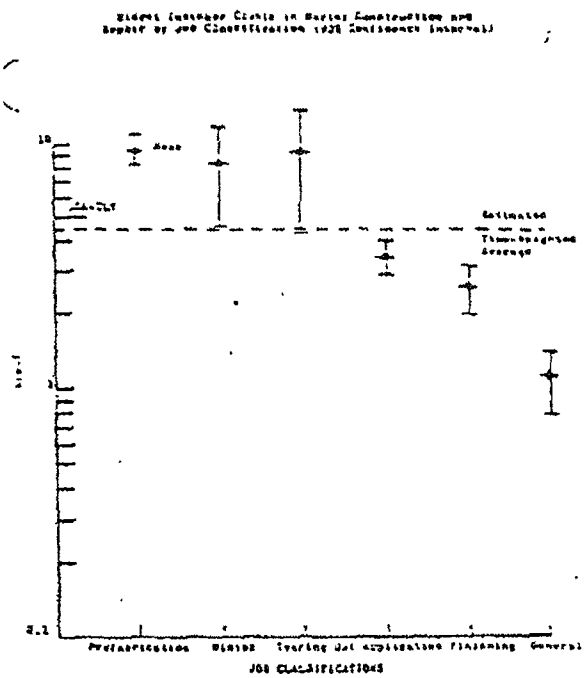
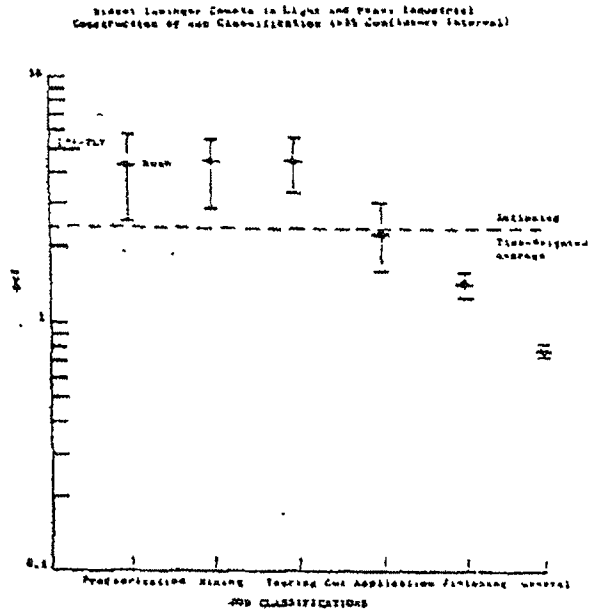


Figure 4



Fiber counts similarly were not found to be as high as anticipated. Those in industrial rations averaged within a range that would be categorized as <u>medium</u> by British standards. ure 5. Those for marine construction and repair were somewhat higher. Figure 6.

Figure 5

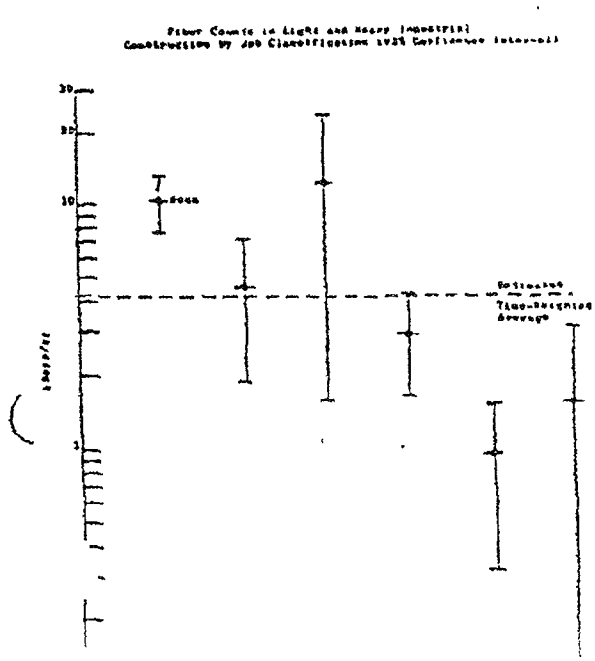
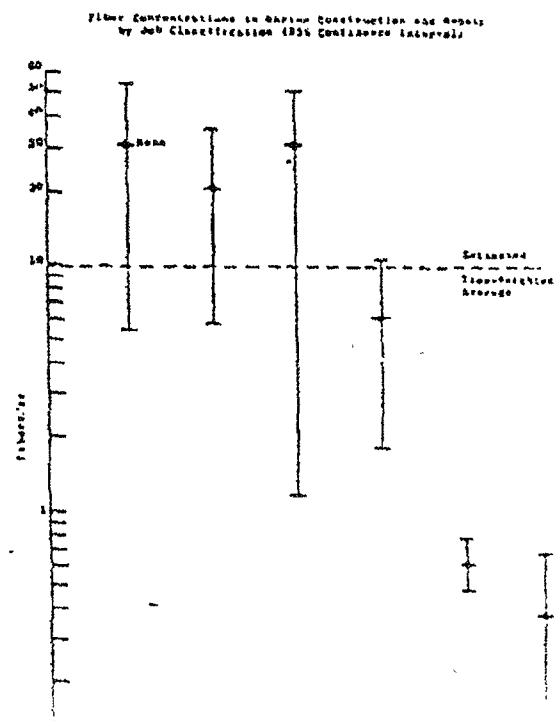


Figure 6



The clearcut evidence of pneumoconiosis and increased lung cancer make it obvious that these workers have had exposures that cannot be tolerated. Retrospective analysis at this time cannot differentiate effects of (1) peak surges as contrasted with time-weighted averages and (2) the possibility that exposures, particularly in marine construction were higher in the period preceeding and during World War II than they are now. We have no evidence, however, to support the latter point. Ferris et al. have reported comparative studies done in New England shipyards in 1940 and 5 using similar instrumentations which indicate no significant reduction in average dust counts, which had not been found to be excessively high in 1940. These findings suggest that a prudent course would be to lower threshold standards and improve present work practices.

Industrial Hygiene

Successful reduction of environmental exposures necessitates as combination of industrial hygiene measures, which must be taken seriously and forcefully implemented. Methods to consider include: (1) substituting less hazardous materials; (2) enclosing certain work areas; (3) providing local exhause ventilation; (4) requiring personal respiratory protection; (5) changing work habits and improving general housekeeping. These points will be taken up in turn.

Substitution of materials, particularly fibrous glass, has been going on for many years, although not for health reasons. In marine and heavy industrial work, there is, however, no suitable substitute for asbestos insulating products, which have actually been increasingly used in our area in recent years because of the increase in heavy industrial construction. Unless it could be shown that asbestos cannot be used safely, abandoning it or prohibiting it would be a drastic recommendation. In our opinion, efforts to use it safely have not yet been vigorously tried.

Enclosing operations entirely or partially is appropriate for prefabrication of fittings and blocks. Muds and cements should be mixed in enclosed booths or automatic mixers and carried to work sites in containers that would prevent evaporation.

Local exhaust ventilation at application sites is impractical in most situations. Large power boiler and steam generator operations could, however, use local exhaust systems since there work often remains in one location for many hours or weeks. Ultimately, it will probably be found practical, even essential, to ventilate more energetically in marine construction and repair, not only to prevent intolerable dust concentrations but also to ameliorate extreme temperature and humidity conditions under which work is being performed. The technical problems to do this can be solved.

Personal respiratory protection is an important adjunct to other measures. Present masks are not worn regularly, even when provided, because they are hot, uncomfortable, increase the effort of breathing, and interfere with communication. Many filter materials, despite this high resistance, do not adequately filter out fibrous materials. Research leading to the development of better-fitting, low-resistance, fiber-removing masks is imperative. In some situations, the insulating worker may have to depend upon a supplied air system; but because of the need for hose and compressor, its usefulness is limited. Personal air supplied respirators with their own power units would be more versatile and could be used for some particularly dusty exposures such as tearing out aboard ship. Inasmuch as fitting and maintenance of masks is recognized as essential if personal respiratory protection is to be effective, the independent nature of many insulators' work makes it unrewarding to think in conventional terms. The idea of an efficient but cheap throwaway mask is being explored by some.

Changing work practices offers great potential. Examples include increased use of properly designed premolded and cut fittings, the use of water sprays to wet material before cutting, the enclosed mixing of muds, the use of industrial vacuum systems for cleaning up and when tearing out.

It is believed that a combination of all the foregoing, properly planned and tailored to meet the different requirements of the many and varied jobs the insulator must do, could

throughout construction sites.

Discussion

A pattern of incidence of asbestosis and the nearly 8-fold ratio between observed deaths from cancer of the lung and pleura and the number expected are in general agreement with other studies of insulating workers. Thus, Selikoff et al. found 6,8 times the expected number of respiratory cancer deaths and Kleinfeld et al., 8,4 times, quite similar to our finding of 7,9 times. Our population was exposed to both chrysotile and amosite. There is no evidence that they have ever had significant crocidolite exposure. Prospective studies may develop patterns that relate to the changing usage of chrysotile and amosite; but the use of various combinations of types and the variable latency of tumors make it unlikely that these causative factors can ever be satisfactorily separated.

The relatively large number of currently employed insulating workers who have never smoked cigarettes or who have quit for at least 1 year provide an extremely valuable population for prospective study relating to the interaction between asbestos and cigarette smoking (Selikoff, 1967).

Existing dust levels, whether measured by midget impinger or fiber counts from membrane filters, were not as high as had been anticipated. The time-weighted averages were within the present threshold limit value of 5 million particles per cubic foot, even for men working fulltime with asbestos. In reality, most men work less than half of this with such materials. Fiber counts were on the average between 2 and 10 fibers/cc. Nevertheless, there was evidence, as pointed out above, for both asbestosis and excessive tumor incidence. The possible explanations are (1) exposures in the past were much higher; (2) the peak dust and fiber counts are more important than the averages; (3) there are other substances present in insulating materials which augment the asbestos effect; and (4) our present permissible levels are too high; and (5) the shipyard exposures during the period 1940 to 1945, being largely amosite and continued at rather high levels over several years, may be major contributors to the present situation.

In our opinion, in the absence of any evidence that work practices have changed sufficiently to blame present asbestosis on extreme conditions in the past and uncertainty as to levels necessary to reduce cancer rates, we think it is prudent that insulating workers not be permitted to work under any conditions that exceed 5 mppcf by midget impingers and that industrial hygiene and personal protective equipment be geared toward these objectives. Due to the changing work sites and relatively independent nature of the insulating workers, providing adequate industrial hygiene is difficult. Our experience suggests that at least in the United States joint union-management programs will be necessary for the education of workers and contractors and for the effective implementation of rules for satisfactory work practices.

A medical program to maintain appropriate surveillance over insulating workers should include periodic chest films and estimates of pulmonary function, the latter for comparative purposes, and to detect other respiratory disease upon which even minor asbestosis would be disastrous. The effective early detection of lung cancer as a discouraging problem at present. It is our conviction that sputum cytologic study needs much further application and study than it has here-to-for received.

Summary

The working environment and health status of insulating workers in the San Francisco area and in several other metropolitan areas of the Western United States were studied during the period 1965 - 67. The installation of insulating materials in these areas is done by members of a single international union with a stable membership now numbering approximately 4,800 men. Their job assignments can be classified as heavy and light industrial and marine construction and repair. Major insulating materials used are asbestos containing (45 %);

arise from adhesives, noise, and heat exposures. Work patterns have been analyzed and show that most men now in the trade have performed in all major job classifications and have used all basic materials. Dust concentrations were studied by midget impinger and membrane filter sampling. The former indicated time-weighted averages in nearly all work situations below the present threshold limit value of 5 million particles per cubic foot. Nevertheless, there are roentgenographic changes consistent with asbestosis in 25 % of the membership, ranging from none in men under 10 years in the trade to over 50 % in those with over 30 years in the trade. The incidence of cancer of the lung and pleura during the period 1946 to 1965 in men with over 20 years since joining the trade was 7,9 times expected. Two deaths from pleural mesothelioma occurred in 1963 and 1964 in men with 43 and 46 years since joining the trade. Recommendations are included for improved industrial hygiene, relating to work practices and respiratory protection, for medical surveillance, including periodic sputum studies.

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