JMEA 5191+

Standards for occupational asbestos exposure

Background information

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A. Two approaches may be considered

1. A standard which specifies a Threshold Limit Value only: presumably, if dust concentrations are kept below the limits set, disease will not occur. Qualifications may be added, as "peak" values and "time weighted averages," when environments are variable.

2. Performance standards: work practices and techniques are specified which are designed to keep environmental conditions satisfactory. Environmental measurements are still made to ensure that equipment and practices are in proper order, but these can be much more limited and the results of samples are much easier to interpret.

B. Obviously, these two kinds of standards are not mutually exclusive, and TLV's can be used as the basis for developing and monitoring performance standards, but there are important differences.

1. It is much easier to follow performance standards. Whether or not exhaust ventilation equipment is used is usually clear, for example. On the other hand, air sampling and dust counting requires special skills and equipment.

2. Performance requirements can be evaluated by all operation personnel: atmospheric dust concentrations can only be measured by a trained individual.

3. Performance requirements are ongoing: if a control measure becomes inoperative, production can stop. Counts are always after the fact.

4. As a corollary, performance standards can cover all aspects of the problem. Counts are limited in number and time, and refer to relatively few operations.

5. Counts are hopelessly inadequate to reflect the great variability (in time and kinds of operation) of many asbestos uses. There may be a very few operations which give "constant" levels, but these are uncommon.

6. Peak exposures can be controlled by performance standards. They are difficult to encompass in TLV approaches and may be obscured in time weighted averages.

7. Performance standards will assist in control of indirect and area exposures; rarely monitored by counting.

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C. Attempts to set TLV's at this time are faced with several serious difficulties.

1. The most important is the long period which must elapse between inhalation of asbestos and evidence of disease. Even x-ray change is infrequently seen before 10 years have passed, and significant breathing defects or cancer are usually found only after 20, 30 or more years. Unfortunately, very few reliable dust measurements were made 20-30 years ago, to relate to disease now being seen.

   It is possible to measure dust levels now and to try to evaluate what changes probably occurred in conditions over the years. This indirect process has some value, but is at best artificial and inconclusive. Such dust counts as were previously done used different collecting devices, different counting techniques and were not limited to asbestos fibers. It is questionable whether one can apply the limited data available to current practices.

2. For many asbestos uses, no correlations of asbestos dust levels and resulting disease can be made.

   a. Even in the asbestos products industry, disease data are scant.

   b. For many other industries using asbestos, neither dust counts nor disease experiences are known.

3. At best, attempts to establish TLV's have been concerned with preventing lung scarring (asbestosis). This is only part of the problem - 3/4 of excess deaths among asbestos insulation workers, for example, are due to cancers of various types.

   There are no data relating to TLV's for the prevention of cancer

   It is well established that asbestos cancer (mesothelioma) can occur after exposure insufficient to result in radiologically evident asbestosis. Thus, any TLV for asbestos would have to be less than that needed to prevent asbestosis, if we are to hope to prevent asbestos-induced cancer.

   Since we do not, at this time, have data to confidently predict levels that would prevent asbestosis, it is difficult to establish a meaningful level to prevent asbestos cancer.

4. At this time, even if a TLV were known that would, if adhered to, result in prevention of asbestos disease, as a practical matter, it cannot now be utilized as a major determinant in a control program.

   a. Few enforcement agencies have people trained in required sampling and counting techniques.

   b. Most states do not even have the kind of microscope ("phase contrast") needed to do these counts.

c. The NIOSH plans a training couse for technicians in these techniques. It may require several years to train sufficient staff, procure equipment and institute adequate air monitoring programs.

5. Current experience indicates that many industrial asbestos exposures are greatly excessive. Counts of 300 fibers/cm^3 have been recorded, and many operations result in occupational exposures of 50-100 fibers/cm^3.

Simultaneously, many engineering practices are known that would sharply reduce such exposures. In large part, these are not being utilized.

Summary

1. No data now exist which will allow the designation of a TLV that, if enforced, could confidently be predicted to prevent asbestosis, in the variety of industrial uses now known.

No lower "safe level" has yet been defined, although it is likely that one exists.

Consideration of a TLV "for asbestos" is a misnomer. The only data being considered are those expected to prevent lung scarring or asbestosis. Such a TLV could be listed as "only for the prevention of asbestosis."

Such a TLV is not necessarily designed to prevent asbestos cancer. What limit is necessary for this is not known - only, that it is less than that needed to prevent lung scarring.

2. Thus, no "safe TLV" for asbestos is now known.

3. Much is known, however, about how to prevent dusty work environments. This knowledge is often not utilized.

4. Discussion of "TLV's" is largely irrelevant to current occupational asbestos exposure of workmen. Rather, every industrial use must utilize best available control techniques, or be discontinued until alternate practice can be demonstrated not to result in human disease, especially cancer.

5. Performance standards should rapidly be set for every industrial asbestos use, by joint consultation of industry, labor and industrial hygiene engineers. Use of asbestos should be prohibited if such standards are not followed, without waiting for dust counts.

6. In setting performance standards, two guides should be used.

a. The best engineering techniques available.

b. In no case, should use be allowed that would result in a workman remaining unprotected in atmospheres containing more than 2 fibers/cm^3.*

*Harries, P.G. Ann. Occup. Hygiene. 14:241-254, 1971. "The sampling is done routinely in Naval Dockyards and workmen are not allowed to work unprotected in compartments in which the asbestos fibre is more than 2 fibres/cm^3." (Royal Navy, Great Britain.)

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Table G[1]

Observed and Expected Number of Deaths
Among 632 Asbestos Workers Exposed to
Asbestos Dust 20 Years or Longer, 1943-1962

Cause of Death	Years 1943-1947	1948-1952	1953-1957	1958-1962	Total, 1943-1962
Total, all causes.....					
Observed (asbestos workers)	28	54	85	88	255
Expected (US white males)..	39.7	50.8	56.6	54.4	203.5
Total cancer, all sites.....					
Observed (asbestos workers)	13	17	26	39	95
Expected (US white males...	5.7	8.1	13.0	9.7	36.5
Cancer of lung and pleura....					
Observed (asbestos workers)	6	8	13	18	45
Expected (US white males)..	0.8	1.4	2.0	2.4	6.6
Cancer of stomach, colon and rectum.....					
Observed (asbestos workers)	4	4	7	14	29
Expected (US white males)..	2.0	2.5	2.6	2.3	9.4
Cancer of all other sites combined.....					
Observed (asbestos workers)	3	5	6	7	21
Expected (US white males)..	2.9	4.2	8.4	5.0	20.5
Asbestosis.....					
Observed (asbestos workers)	0	1	4	7	12

Death rates as reported annually by the U.S. National Office of Vital Statistics. A five year average is given here for each period.

Death rates include cancer of lung, bronchus, pleura, mediastinum and trachea, assigned to international list code No. 47b-f prior to 1949, and to No. 160-164 thereafter.

Expected and observed deaths among 370 asbestos insulation workers, Jan. 1, 1963 - June 30, 1971.

	Observed deaths	Expected deaths*
Total cancer (all sites)	92	15.1
Cancer of lung, pleura, trachea, bronchus	47	4.5
Lung cancer	43	+
Pleural mesothelioma	4	‡
Peritoneal mesothelioma	19	‡
Cancer of stomach, colon and rectum	12	3.0
Cancer all other sites	14	7.6
Asbestosis	20	‡
All other causes	51	63.5
Total deaths	163	78.6

*Expected deaths are based upon age specific rates for U.S. white males in 1967. Smoking habits are disregarded.

+United States data not available but figure should be only slightly less than 4.5.

‡United States data not available but these are rare causes of death in general population.

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Deaths among 890 asbestos insulation workers who joined Union Jan. 1, 1943-Dec. 31, 1962, and followed to June 30, 1971

	Before 20 years	After 20 years
Lung cancer	0	9
Pleural mesothelioma	0	1
Peritoneal mesothelioma	0	1
G.I. cancer	1(19)	0
All other cancers	1(18)	2
Asbestosis	0	1
All other causes	13	11
	15	25

Deaths among 632 asbestos insulation workers,
N.Y.-N.J., Jan. 1, 1943 - June 30, 1971

	Elapsed period from onset of employment (years)						
	10-19	20-29	30-39	40-49	50-59	60+	Total
Lung Cancer							
Number	0	11	30	31	12	1	85
Percent	0	12.9	35.3	36.5	14.1	1.2	100.0
Mesothelioma							
Number	0	1	14	13	1	1	30
Percent	0	3.3	46.8	43.3	3.3	3.3	100.0
Asbestosis							
Number	0	1	9	16	6	0	32
Percent	0	3.1	28.1	50.0	18.8	0	100.0

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Causes of death among 230 amosite asbestos factory workers, Jan. 1, 1960 - June 30, 1971*

Cause of death	Observed deaths	Expected deaths**
Total cancer, all sites	43	8.5
Cancer of lung, pleura, bronchus, trachea	27	2.4
Lung cancer	25	+
Pleural mesothelioma	2	‡
Peritoneal mesothelioma	3	‡
Cancer of stomach, colon, rectum	5	1.6
Cancer of all other sites	8	4.5
Asbestosis	14	‡
All other causes	48	37.9
Total deaths	105	46.4

*333 workmen were employed in this factory one year or longer, 1941-1945. 88 died by Dec. 31, 1959. 15 were lost to follow-up. The remainder, 230, have been studied to June 30, 1971. Analysis of lifetime work experience indicates that, for the very large majority, this was the only occupational asbestos exposure.

**Expected deaths 1960-1964 are based on U.S. age-specific rates for white males in 1962. For 1965-1971, rates for 1968 were utilized. Smoking habits are disregarded.

+United States data not available, but figure should be only slightly less than 2.4

‡United States data not available but these are rare causes of death in general population

X-Ray changes in amosite
asbestos factory workers
25-30 years after onset of exposure*

Number	Duration of Employment	Asbestosis** None (0)	Minimal (1)	Moderate (2)	Extensive (3)
14	Less than 1 week	6	7	1	0
77	1-12 weeks	18	55	4	0
71	3-12 months	7	48	12	4
74	1-3 years	5	48	16	5
31	More than 3 years	3	9	9	10
267					

*933 workmen employed in this factory 1941-1945.
504 were alive 25 years after onset of employment.
268 were examined (in one instance lung cancer made interpretation uncertain).
234 not examined [47 deceased when located, 38 ill or infirm, 58 unavailable (out-of-state, jail, mental institutions), 91 refused].

**X-Ray appearance on modified Saupe scale, in films taken 25-30 years after onset of exposure (i.e., 1966-1971).

ESTIMATED U. S. ASBESTOS CONSUMPTION

Construction Industries vs Non-construction Industries
(Short Tons)

	Construction Industry		Non-Construction Industry		
	Tons	%	Tons	%	Total
1920	63,600	40.8	92,400	59.2	156,000
1925	141,600	69.1	63,200	30.9	204,800
1930	136,200	66.0	70,300	34.0	206,500
1935	101,700	58.2	73,000	41.8	174,700
1940	160,200	61.1	102,000	38.9	262,200
1945	214,500	56.7	163,500	43.3	378,000
1950	354,300	48.6	374,400	51.4	728,700
1955	444,300	60.0	296,100	40.0	740,400
1960	437,400	65.3	232,100	34.7	669,500
1965	532,300	74.0	187,400	26.0	719,700

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WORLD PRODUCTION OF ASBESTOS

1879-1929

	1879-1909	1910-1929	Total
Total World Production	695,606	4,123,780	4,879,386
Total Cape Province Production	5,601	54,977	60,578
Total Canadian Production	586,035	3,114,270	3,700,305

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