A PRIMER ON RETROSPECTIVE EXPOSURE ASSESSMENT:
THE SCIENCE OF INDUSTRIAL HYGIENE

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A. BACKGROUND

In order to understand retrospective exposure science in the asbestos arena, you must understand the basics of industrial hygiene. Industrial hygiene has long been recognized as a legitimate and essential science in the broad field of occupational health. One fundamental function of industrial hygiene is the recognition, evaluation and control of health risks from chemical, biological and physical hazards in the workplace. In order to perform this function, industrial hygienists perform exposure assessments. Since it is impossible to monitor all individuals for all hazards at all locations and times, industrial hygienists often have to make professional judgments as to when and where to collect, compare, and sometimes extrapolate, relevant sample data. Workplace sampling and comparison with established standards such as those promulgated by the Occupational Safety and Health Administration (“OSHA”) are routine activities in the practice of industrial hygiene.

Industrial hygienists and the research measurements that they perform continue to remain a staple in the advancement of workplace safety and the promulgation of public safety standards. The American Conference of Government Industrial Hygienists (“ACGIH”), founded in 1938, was the first organization in the United States to promulgate standards for acceptable exposure to particular substances in the workplace. The United States government later adopted many of these standards as law. For example, the ACGIH’s asbestos standard, promulgated in approximately 1946, was adopted in 1958 by the United States government via the Walsh-Healey Act to protect employees of federal contractors.
The use of retrospective exposure assessment is inextricably linked to the promulgation of public policy and the development of risk assessment models. Indeed, a number of governmental agencies have used retrospective exposure assessment as part of their regulatory function, including the Agency for Toxic Substances and Disease Registry (“ATSDR”), NIOSH, the National Academy of Sciences/National Research Council, EPA, OSHA, and FDA. Without this type of analysis, these agencies would be incapable of performing their essential function in safeguarding public health.

B. WHAT IS RETROSPECTIVE EXPOSURE ASSESSMENT?

Retrospective exposure assessment is a modeling formula used to calculate a person or group’s past exposures. While there are several acceptable methods for this type of exposure analysis, depending upon the amount and type of data available, all generally involve calculating exposures (to asbestos, silica, benzene etc.) for particular jobs or tasks and then multiplying by the subject’s exposure to said jobs or tasks.

The medical and scientific literature is replete with peer-reviewed articles of studies which utilize the industrial hygiene technique for retrospective exposure assessment. This technique is not confined to the estimation of asbestos exposure; it is widely used to reasonably determine levels of exposure to various potentially toxic agents. In their book *A Strategy for Assessing and Managing Occupational Exposure*, Mulhausen and Damiano observe that

> The accuracy of the exposure characterization increases not only with more monitoring results but also with more and better qualitative information (i.e., knowledge of how exposures are affected by workplace, workforce, and environmental agent factors).

> Models are not limited to predicting present-day exposures. They can be used to estimate historical exposures that cannot be recreated, as well as possible future exposures in hypothetical situations.
It is important to understand the practice of retrospective exposure assessment and how it is utilized in the scientific and medical communities worldwide. Exposure assessment “is the step in the risk assessment process that quantifies the uptake of an agent resulting from contact with various environmental media (e.g., air, soil, food).” Paustenbach DJ, “The Practice of Exposure Assessment: A State-of-the-Art Review,” *J. Toxicol. Environ. Health, Part B*, 3:179-291 (2000). Such assessments can estimate past, present or future exposures. They determine the degree of contact a person has had with a particular substance, such as asbestos, and estimate the magnitude of the absorbed dose. *Id.*

As with any scientific calculation, results that inspire confidence demand good data. Scientists may rely upon published data and samples from other studies. They may employ mathematical models to increase the certainty of their estimates and to decrease the problems associated with over-reliance on conservative assumptions. *Id.* at 183. Indeed, the EPA has adopted modeling to assist in problematic risk assessment. *Id.* at 183-84.

In order to perform a retrospective exposure assessment in the asbestos context, the industrial hygienist must first determine time, duration, number and frequency of potential past asbestos exposures. Since it is rare to have full documentation outlining a worker’s specific job duties on a daily basis, one method of acquiring this information (outside the context of litigation) is through questionnaires and interviews with the subject and his co-workers. *Mulhausen & Damiano, A Strategy for Assessing and Managing Occupational Exposure*, Ch. 3, 5. Such interviews focus on the time, duration, number and frequency of such potential exposures created by working with or around potentially asbestos-containing materials.
These interviews can elicit product identification, product use and proximity to use. They may also garner information regarding the setting of the potential exposure area such as the size of the area, presence of ventilation, or other protective measures. In lieu of information derived from interviews, indirect information can also be derived from the scientific, peer-reviewed literature that may present sample tasks, job duties and exposure rates for similarly situated persons. Workplace records or job descriptions may also serve as secondary sources in recreating exposure measurements.

Once such information is collected, the industrial hygienist then calculates the exposure from one of several sources. In a few instances, where actual measurements from the specific workplace are available, such workplace measurements may be used as a baseline and then extrapolated to the persons in the subject’s position and duties. *See* EXPOSURE ASSESSMENT FOR EPIDEMIOLOGY AND HAZARD CONTROL 189 (S. M. Rappaport & Thomas J. Smith eds., 1991). More commonly, the descriptions of a plaintiff’s work are used as a baseline to search the scientific literature for exposure measurements of similarly situated persons performing similar tasks.

Based upon industry-wide articles, corporate documents, communications from knowledgeable persons, MSDS sheets, independent testing, and other information regarding product content, claimed use, foreseeable use, friability, longevity, stability in the workplace and exposure characteristics, the industrial hygienist can further refine his calculations. Depending upon the quality and amount of information acquired, the industrial hygienist may calculate both quantitative and qualitative dose estimates. With more limited information, the industrial hygienist can perform a quantitative analysis that may describe the existence or nonexistence of asbestos exposure. Qualitative assessments are used to rank exposures from different sources,
separate trivial from significant exposure sources, and compare exposures with those necessary to prevent a risk of disease.

Based upon the data previously described, an industrial hygienist can calculate the total asbestos exposure for a particular plaintiff’s job task, job site, cumulative occupational lifetime, cumulative non-occupational lifetime, and total cumulative lifetime exposures. See EXPOSURE ASSESSMENT FOR EPIDEMIOLOGY AND HAZARD CONTROL 189, 192 (explaining that “cumulative exposure estimates were calculated by merging the work histories of study subjects with the job-exposure-time matrix … Linear modeling of engineering and work practice data also shows promise as a method to extrapolate current data to previous conditions”). This data can be further refined to provide the same analysis with respect to either an individual product or the products from an individual manufacturer.

In the litigation context, this information is of considerable utility to the judge and jury in understanding a number of issues. Retrospective exposure assessment data can demonstrate that exposure to asbestos in a product was non-existent, or below the then-existing permissible exposure limits recognized by science, industry or government, or below background levels for a particular location, or below the minimum threshold level for the dose/response relationship to the disease process at issue. It may also indicate that exposures to other products or other types of asbestos were more significant in terms of amount and potential carcinogenicity. Typically, retrospective exposure measurements are expressed in terms of a range rather than an exact calculation.
C. **ACCEPTANCE OF RETROSPECTIVE EXPOSURE ASSESSMENT IN SCIENCE AND GOVERNMENT**

A number of governmental agencies, including NIOSH, OSHA and EPA, use retrospective exposure analysis to make public policy decisions and develop risk assessment models. *See, e.g.*, Environmental Protection Agency Guidelines for Exposure Assessment, 57 Fed. Reg. 22888 (May 29, 1992); Centers for Disease Control and Prevention, Dept. Health & Human Servs., DHHS Pub. No. 2002-126, Exposure Assessment Methods: Research Needs and Priorities, Department of Health & Human Services (2002). Retrospective exposure assessments are also used in the medical field and are an important tool in confirming medical diagnoses. Medical doctors, radiologists and pathologists often make diagnoses conditional upon a subsequent determination of asbestos exposure in an amount sufficient to have caused the relevant disease process. Exposure history thus plays an important role in the differential diagnoses performed by medical professionals.

Reliance upon retrospective exposure assessment is not “new” or “novel.” A review of the published peer-reviewed literature indicates that retrospective exposure analysis has been accepted by the scientific community for decades (including those experts traditionally retained on behalf of plaintiffs in asbestos litigation). A key selection of historical articles embracing retrospective exposure analysis includes the following:


*Applied Occupational and Environmental Hygiene*, (Entire Issue), Volume 6, Number 6, June 1991.


Indeed, Dr. Irving Selikoff, one of the preeminent clinicians of asbestos medicine, used retrospective exposure techniques to determine exposure rates for similarly-situated workers. In his article “Mortality Experience of Amosite Asbestos Factory Workers: Dose-Response Relationships 5 to 40 Years after Onset of Short-Term Work Exposure,” he concluded that there was a dose response relationship with higher exposures to asbestos resulting in higher incidents of cancer. Seidman H., Selikoff I.J., Gelb S.K., “Mortality Experience of Amosite Factory Workers: Dose-Response Relationships, 5 to 40 Years after Onset of Short-Term Work Exposure,” *Am. J. Ind. Med.*, 10: 479-514 (1986). Since he did not actually measure the exposures of the subjects in his study, he used exposure measurements from similarly situated workers from another plant in another state. In fact, he used the data provided by Dr. Richard A. Lemen, then acting director of NIOSH. This data allowed him to calculate the “direct asbestos dosage” by multiplying the subject’s length of time at the factory performing a job task by the estimated fiber exposure associated with that particular job as derived from similarly situated workers. This study clearly demonstrates the methodology used by Dr. Selikoff—namely, the evaluation of data from similarly-situated workers—supports his conclusions regarding the dose-response relationship.

D. CONCLUSION

Despite some recent criticisms over its use in asbestos litigation, retrospective exposure assessment been subjected to peer-review scrutiny and publication for decades and is generally accepted as valid by industrial hygienists, epidemiologists, and occupational health professionals around the world. Moreover, many governmental agencies charged with protecting public health, including EPA, OSHA, FDA, NIOSH, and ATSDR, among others, rely on retrospective exposure analysis for regulations that govern occupational exposures. Although retrospective exposure analysis has proven useful to judges and juries in the context of litigation, it is certainly not a creature of litigation.