

STUDY OF EXPOSURE TO ASBESTOS WHEN USING USSteel'S TIGER BRAND ASBESTOS-CONTAINING WIRE/CABLE

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INTRODUCTION

The undersigned were retained by counsel representing USX Corporation - U.S. Steel Group ("U.S. Steel") to evaluate potential exposure to asbestos during typical operations involving the use of asbestos-containing electrical wire/cable manufactured by a former division of U.S.Steel, originally known as American Steel & Wire. We were asked to design and direct this project because of our 1) individual experience and expertise in the comprehensive practice of industrial hygiene, including monitoring of exposures, 2) familiarity with the history of acceptable exposure limits for asbestos including threshold limit values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and the permissible exposure limits (PELs) promulgated by the U. S. Department of Labor's Occupational Safety and Health Administration (OSHA), 3) knowledge of asbestos exposure monitoring techniques and analytical procedures, and 4) knowledge of a wide range of asbestos applications.

On the basis of our background, described above, and our familiarity with the major issues involved in litigation alleging overexposure to asbestos resulting from use of asbestos-containing electrical wire/cable manufactured by U.S.Steel, we designed the protocol for a series of tests. The objective was to document the actual exposure of a worker while performing typical electrician's activities, i.e., cable pulling and splicing, using electrical wire/cable manufactured by U.S.Steel. On Wednesday, January 15, 1997, tests were conducted in specially-prepared facilities of RJ Lee Group laboratories located in Monroeville, Pennsylvania. RJ Lee Group was selected because of the firm's experience and capabilities related to this type of study. They are accredited by the American Industrial Hygiene Association and the National Institute of Standards and Technology, as well as various state agencies, for analysis of asbestos in both air and bulk samples. This report describes the

background for the study, describes the research design and methodology, presents the results of the tests performed during that study, summarizes the significance and expresses conclusions based on the findings.

BACKGROUND

Asbestos is a term used to describe a number of naturally-occurring hydrated minerals, chemically defined as silicates, that are separable into filaments or fibers. Several mineralogical forms of asbestos exist; the most common form in this country is chrysotile, derived from serpentine. Other less common forms include amosite and crocidolite, which are fibrous amphiboles. Asbestos possesses high tensile strength and flexibility of the fibers; these properties together with its extraordinary resistance to heat, abrasion and many chemicals, have made asbestos uniquely suited for a broad range of industrial applications, particularly those in high-temperature processes. Among these was electrical wire/cable designed for use in high-temperature applications. Some of U.S.Steel's Tiger Brand electrical wire/cable was designed for use in such service. As was common in the wire/cable industry, U.S.Steel incorporated asbestos in insulation in some of the composite layers of a small number of their wire/cable products.

Because of the presence of asbestos in the wire/cable insulation, questions regarding potential exposure to asbestos released from the wire/cable have been raised. It is important to note that there has been an evolution of acceptable exposure limits recommended for asbestos over the years. In 1946, and in keeping with its mission, the American Conference of Governmental Industrial Hygienists (ACGIH) established a maximum allowable concentration (MAC), later referred to as threshold limit value (TLV), for asbestos of five (5) million particles per cubic foot (mppcf), based on the impinger-count method of sampling and analysis. This method required drawing air through an impinger containing a liquid, usually water, in which the particulate material in the air stream was collected. A portion of the resulting sample was examined microscopically and the observed particles were counted. This information, together with the measured volume of air sampled, was used to calculate the

concentration of particles in the air in units of "millions of particles per cubic foot of air sampled. ACGIH's "TLV" is the airborne concentration of a substance to which it is believed workers can be exposed repeatedly, for a working lifetime, without experiencing adverse effects. Prior to passage of the Occupational Safety and Health Act of 1970, the ACGIH was the most significant advisor to users of various substances with regard to acceptability of exposures. The 5 mppcf level remained as the ACGIH recommended limit from 1946 until 1973. In 1968, ACGIH proposed a new limit for worker exposure, based on the filter-count method, of 12 fibers per cubic centimeter of air (f/cc). The filter method required drawing air through a suitable filter to collect the particulate material and counting "fibers" as defined in the method using phase contrast microscopy (PCM); this allowed calculation of the concentration of "fibers per cubic centimeter of air sampled". In 1970, ACGIH proposed lowering the TLV to 5 f/cc; this limit was adopted in 1973 and remained the recommended limit until 1979. In 1980, ACGIH recommended different limits for the three most common forms of asbestos: 2 fibers/cc for chrysotile (the most common form), 0.5 fiber/cc for amosite, and 0.2 fiber/cc for crocidolite. In 1991, they proposed to establish the limit at 0.2 fiber/cc for all forms of asbestos, a recommended limit that remains under consideration.

The U. S. Department of Labor's Occupational Safety and Health Administration (OSHA) promulgated a standard for occupational exposure to asbestos in 1972, reducing the permissible exposure limit from the original (1971) level of 12 fibers per cubic centimeter of air (f/cc) to 5 f/cc. This limit has been reduced over the years to 2 f/cc in 1976, to 0.2 f/cc in 1986, and to 0.1 f/cc in 1994. It is important to note that current OSHA standards concerning occupational exposure limits do not ban the use of asbestos but rather impose more stringent controls in asbestos use. In addition to the permissible exposure limit requirements promulgated by OSHA, there is a requirement for a range of controls and practices to be implemented whenever there is reason to believe that workers are being exposed to asbestos above the permissible exposure limit.

U.S.Steel has been named as one of multiple defendants in a variety of cases in which plaintiffs have alleged overexposure to asbestos either (1) directly, i.e., the plaintiff's work

required handling and use of asbestos-containing electrical wire/cable or (2) as a bystander, i.e., the plaintiff worked in the vicinity of workers who were handling the wire/cable. Key to the legal issues involving asbestos exposure is knowledge of the magnitude and significance of actual exposures to asbestos under either of these scenarios. Reports of other parties' tests conducted in connection with this litigation were reviewed prior to design of this study; however, the common literature contains no reports of studies that document workers' exposures to asbestos from handling and using asbestos-containing electrical wire or cable. Accordingly, it was decided to design and conduct a study in which the exposures of a worker engaged in actual tasks typical of an electrician's trade could be monitored and documented. The fundamental questions addressed in the study were:

1. What concentrations of asbestos fibers released from asbestos-containing electrical wire/cable is a person exposed to during the various specific activities representing an electrician's typical job?

2. What concentrations of asbestos fibers would persons be exposed to as a result of working in the vicinity of others using asbestos-containing electrical wire/cable to perform an electricians' jobs?

3. Are these concentrations within the acceptable exposure limits that have been recommended for asbestos historically, as well as under current standards?

RESEARCH METHODOLOGY

It was decided that a series of tests would be conducted in order to obtain answers to the questions set forth in the preceding section. On Wednesday, January 15, 1997, tests were performed to determine what exposure to asbestos, if any, a worker would receive while performing normal electrician activities involving use of asbestos-containing electrical wire/cable manufactured by U.S.Steel, i.e., USS Tiger Brand wire/cable.

THE CABLE

An initial concern in conducting the study was the scarcity of U.S.Steel Tiger Brand wire/cable available for the tests. Concerted efforts had been made throughout the years to obtain samples of the cable; eventually, a section of cable about 21 feet long was located in an abandoned warehouse at a retired location of U.S.Steel. This cable, which was more than 20 years old, was U.S.Steel's Tiger Brand, Type AVA, No. 4, seven-strand, single-conductor electrical cable, rated at 600 volts, as verified by inspection and the stenciled identification on the exterior of the cable.

The section of cable was delivered to the RJLee Group laboratories in Monroeville where the various composite layers of the cable product were identified and analyzed. The eight identified layers surrounding the copper conductors were (from exterior to interior) 1) a black exterior coating of organic material, primarily asphalt and wax, 2) a layer of twisted fibrous braids containing asbestos (chrysotile), 3) a bundle of fibrous glass, 4) a paper-like layer mainly of chrysotile, 5) another bundle of fibrous glass, 6) another paper-like layer (two or three wraps) mainly of chrysotile, 7) a black organic layer (two wraps) with cellulose, and 8) another paper-like layer (two wraps) mainly of chrysotile. The cable sample was tagged by RJLee Group laboratory personnel and remained in their custody until the day of testing.

It was decided to run replicate tests representing two basic tasks typically associated with electricians' work: cable pulling and cable splicing, including the necessary cutting, stripping and terminating activities.

FACILITIES

The tests were performed in a specially-constructed room at the RJLee Group facilities located in Monroeville, Pennsylvania. A diagram of the test room is presented as Figure 1. The room consisted of a structure measuring 16 feet by 16 feet and providing approximately 256 square feet of floor area; ceiling height was approximately 8 feet. Within the room a work table was positioned to provide a foundation from which bench-level activities could be

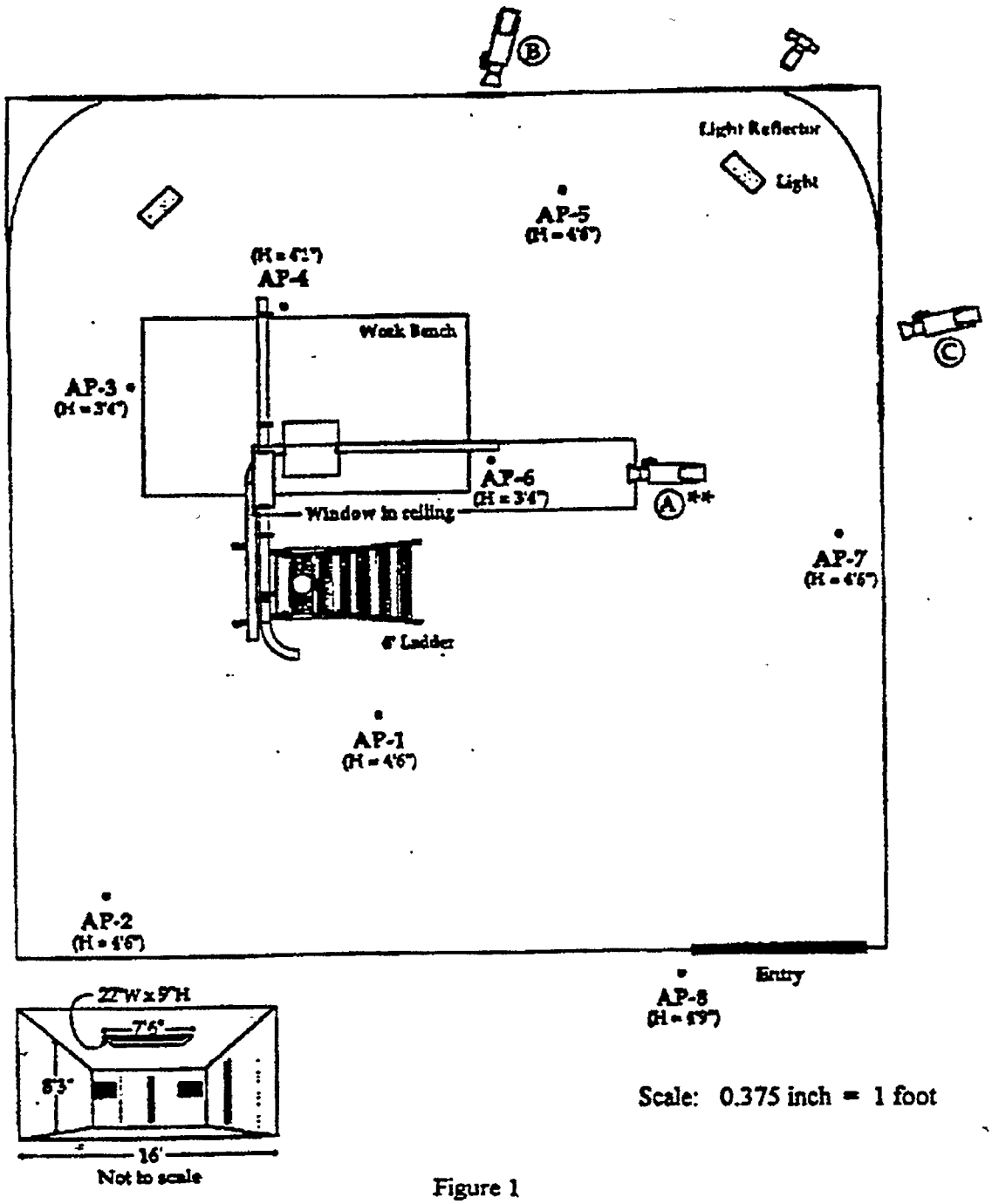


Figure 1

Diagram of Test Room
used for
Evaluation of Exposure to Asbestos

performed. The table included an installed junction box to which were attached a straight-section run of approximately three feet of 1 1/4-inch conduit and a section of approximately three and one-half feet that included a 90-degree turn of approximately 7 1/4-inch radius. In addition to the set-up on the table, a junction box was attached to the ceiling of the room in order to represent typical overhead work; a straight-section run of approximately three feet and a 90-degree turn section (radius of 7 1/4 inches) approximately three and one-half feet long were attached to opposite ends of the junction box. Each junction box measured one foot by one foot and was four inches deep. No mechanical ventilation of the enclosure was provided.

PERSONNEL

The activities involving typical use of the cable were conducted by Mr. William S. Miron, a journeyman electrician with 25 years of experience and currently employed full-time at an industrial facility and is a member of the UAW. His background and experience includes employment as an electrician at steel mills where he performed general mill maintenance, installation and repair of electrical equipment.

The overall protocol and conduct of the tests were overseen by the undersigned, Dr. Robert D. Soule and Mr. John B. Masaitis. Mr. Masaitis is a certified industrial hygienist with more than 35 years experience in the comprehensive practice of industrial hygiene. He was employed by the Commonwealth of Pennsylvania, Department of Health for two years prior to joining U.S.Steel in 1964 and retiring in 1996. For the last five years of his employment, he was responsible for the corporate industrial hygiene program at U.S.Steel. Dr. Soule is certified in industrial hygiene and as a safety professional and is licensed as a professional engineer in several states. His 30 years of experience include employment with the Dow Chemical Company, Clayton Environmental Consultants, the Pennsylvania/OSHA Consultation Program and Indiana University of Pennsylvania. Dr. Soule has been acquainted with the safety and health programs at U.S.Steel for most of his 30 years of professional practice and has had an opportunity to visit many of its major facilities; he is familiar with its industrial hygiene and safety programs and practices.

As previously discussed, the tests were performed at the RJLee Group facilities. Dr. Richard J. Lee, president of RJLee Group, was involved closely in the design and development of the test facilities and was responsible for the support provided during the testing and the subsequent analysis of air samples.

ELECTRICIAN'S ACTIVITIES

The electrician's equipment used during the tests was that owned by Mr. Miron and, thus, he was familiar with it. He was instructed to use all equipment and associated hardware as he normally would in performing the cutting, stripping, terminating and splicing tasks with the cable.

The tests with the cable were conducted in segments of a minimum of thirty minutes each. During each segment, the electrician evenly divided his activities between the overhead junction box arrangement and the one installed on the benchtop by alternating work locations approximately every ten minutes.

The first two test periods were used for evaluation of the "cable pulling" activity. The length of cable was cut in half so that two cables could be pulled through the conduit together, as is done typically. During Test 1, the electrician pulled cable through the overhead setup for ten minutes, switched to the benchtop setup for a ten-minute period, and then returned to the overhead arrangement for a final ten minutes. The cable was pulled through the conduit a total of 78 times during Test 1, a rate of approximately once every 23 seconds. Test 2 was performed in a manner similar to Test 1 but reversing the sequence of work positions, i.e., the electrician began with ten minutes of pulling at benchtop level, moved to the overhead setup for the second ten-minute period, and returned to the benchtop arrangement for the final ten minutes. The two cables were pulled through the conduit a total of 67 times during Test 2, a rate of approximately once every 27 seconds.

During Test 3, the electrician performed cable splicing, i.e., cutting of the outer layers of the cable sheath with a knife, stripping the materials from the conductor, attaching the

terminals to the exposed ends of the conductors, connecting the terminals (splicing the two conductors together) and taping the resulting splice. As was the case with the cable pulling tests, the electrician alternated work positions between the overhead and benchtop locations. During Test 3, the electrician worked the initial ten minutes overhead, moved to the benchtop setup for the second ten-minute period, and returned to the overhead arrangement for the final ten minutes. Each of these splicings required between three and four minutes to complete.

Test 4 also involved splicing tasks as described for Test 3, the difference being that the electrician began by working at the benchtop position for the first ten minutes, moved to the overhead location for the second ten-minute period, and then returned to the benchtop position. Near the end of the fourth test, it was apparent that there was not enough cable remaining to run a fifth test; therefore, it was decided to extend the fourth test until all of the cable was used up in order to maximize total test time, a total period of approximately 50 minutes. One of the personal monitor cassettes was replaced after approximately one-half hour of activity; all of the general area sampling units were allowed to run for the duration of Test 4 and the Test 4 Extension.

ASBESTOS MONITORING

During the tests, air monitoring devices were used to collect representative samples of the environment within the test room in order to determine the concentrations of asbestos fibers associated with the various electrician tasks. Air sampling was performed in the breathing zone of the electrician, at seven fixed-location sites within the test room and at a fixed-location site just outside the test room.

Two similar personal monitoring devices were worn by the electrician. These sampling systems consisted of small, battery-operated pumps connected to sampling cassettes by means of necessary lengths of tubing. The sampling protocol was that specified by OSHA in the Code of Federal Regulations, Title 29, Part 1910.1001(d)(6)(i) and Appendix A, for collection of asbestos samples. Sample cassettes consisted of polystyrene housings with 50-mm extension cowlings containing 25 mm-diameter mixed cellulose ester membrane filters

(0.8 micrometer pore size). The sampling pumps were attached to the electrician's belt and the filter cassettes were positioned in the electrician's breathing zone, one on each side of his head, and fastened to suspenders worn by him. During the tests, these pumps were operated at nominal flowrates of two liters per minute as specified in the OSHA sampling protocol for this procedure. The sampling unit on the electrician's left shoulder was allowed to run for the entire 5-hour test day. The cassette on the electrician's right shoulder was replaced after a minimum of 30 minutes of activity with any of the electrician tasks. With this approach, it was possible to define the level of asbestos exposure associated with each type of electrician activity, as well as the electrician's time-weighted average asbestos exposure over the course of the entire testing day.

Stationary sampling devices were placed at seven locations throughout the room in order to determine the concentrations of airborne asbestos fibers at various distances and locations relative to the electrician's activities. Sampling systems associated with these locations consisted of electrical pumps (110 volt a.c.) connected to filter cassettes of the same type as those used with the personal breathing zone sampling by means of appropriate lengths of tubing. A nominal flowrate of five liters per minute (5 l/min) was used at each stationary sampling site. The locations of the general area sampling sites are indicated in Figure 1.

All air moving devices, i.e., personal monitoring and general area sampling pumps, were calibrated using an electronic flow meter in order to determine the precise flowrate being provided by each unit. All units were calibrated prior to initiation of the tests, each time filter cassettes were replaced, and at the conclusion of the testing.

At the conclusion of sampling, the filter cassettes were removed from the sampling devices, sealed, labeled, and submitted to the RJLee Group laboratory for analyses. Each filter was analyzed initially using the OSHA reference method for asbestos monitoring based on fiber counting using phase contrast microscopy (PCM). With this technique, a wedge is cut from each filter, mounted on a glass slide, cleared with appropriate dispersion oil and submitted for fiber counting using a magnification of 400X and phase contrast illumination.

Pursuant to analytical protocol, fiber counting was continued until either 100 fibers were counted or 100 fields of view were examined, whichever occurred first. This information, together with field survey data on sampling flow rates and duration of sampling, was used to determine the total number of fibers per cubic centimeter of air drawn through the filter for each individual sample. This is the standard method described in detail as the National Institute for Occupational Safety and Health (NIOSH) Method 7400 and identified in the current OSHA standard as the reference method for determination of occupational exposure to asbestos. It is noted that this method calls for counting all particles that fit the definition of a "fiber", a particle with an aspect (length-to-width) ratio of at least three (3) and a length of at least five (5) micrometers. It is important to note, this procedure does not identify the specific chemical or mineralogical type of fiber, i.e., whether the fibers are asbestos or non-asbestos.

In order to identify the specific nature of fibrous material on the filters, each sample was subjected to analysis by transmission electron microscopy (TEM). This procedure required a small square portion of the sample filter to be cut from the sample, mounted on a special copper grid, and subjected to TEM analysis. With this technique, the individual particles fitting the definition of a fiber, per the PCM method, were subjected to elemental analysis using energy dispersive X-ray techniques. The spectrum produced for each individual fiber was compared to that of the various asbestiform materials and the comparison used to determine whether the particle was asbestos and, if so, which specific mineralogical form it was.

VIDEOGRAPHY

Three separate video cameras and one "still" camera were used to record the series of tests. All cameras were operated by professional videographers under the continuous direction of laboratory personnel and overseen generally by the undersigned. The positions of the video-cameras, relative to the test activities, are indicated in Figure 1.

PRESENTATION OF RESULTS

It is pointed out at the onset of discussion that the tests, by design, exaggerated the conditions to which the electrician was exposed in several ways. The electrician was instructed to work steadily at the various tasks without interruption or rest during each test. During the cable pulling tests, no lubricant was used on the cable, thus maximizing the friction between cable and conduit. The doubled-over cable was drawn through the run of conduit repeatedly and was entirely inserted and removed with each pass. During normal cable pulling, the cable is not subjected to that much contact with the conduit since the purpose is to insert the cable into the conduit, not to pull it through repeatedly. During the splicing tests, the electrician used a knife to cut and strip the coverings of the electrical cable; in typical activity, a stripping tool often is used to remove the covering in a single piece with much less dust and scrap created. These conditions combined to present a "worst case" scenario for the asbestos exposure potential.

Worker's Exposure to Asbestos

The results of the tests to document an individual's exposure to asbestos during routine handling and use of asbestos-containing electrical cable are presented in Table I. Results are presented for each sample collected during the tests in terms of concentration of asbestos fibers per cubic centimeter of air. This was determined based on total fiber counts using the PCM method and the percentage of fibers determined to be asbestos using the TEM method. This approach is consistent with the OSHA reference method as discussed in detail in the asbestos standard (29 CFR 1910.1001, Appendix A and Appendix B, Section 6.7). The combination of phase contrast microscopy and transmission electron microscopy showed clearly that 1) most of the "fibers" produced by the electrician's activities were not asbestos and 2) the only form of asbestos identified was chrysotile, recognized as the form of asbestos of least concern.

Examination of the data shows that the concentrations of asbestos fibers measured in the breathing zone of the electrician ranged from less than 0.007 fiber/cc to 0.045 fiber/cc.

The average concentration to which the electrician was exposed during the testing day, based on averaging the individual testing runs, was less than 0.013 fiber/cc. This is equivalent to the value obtained from the single personal breathing zone sample that was allowed to run for the entire duration of the testing day. This documents the internal consistency of the personal exposure data and underscores the validity of the overall study.

It was concluded by the undersigned, and agreed to and verified by the electrician, that an electrician would not typically engage in activity as intense and sustained as that provided during the tests for more than about five hours in an eight-hour shift. Therefore, and significantly, the concentrations measured during the tests correspond to a full-shift, time-weighted average (TWA) concentration of less than 0.008 fiber/cc, more than twelve times below the current OSHA permissible asbestos exposure limit.

Table I

Measured Breathing Zone Exposure to Asbestos
During Tests with U.S.Steel Asbestos-Containing Tiger Brand Electrical Cable

Test No.	Electrician's Activity	Asbestos Concentration [fibers/cc]	
1	Cable Pull (approx. 30 min.)	<0.007 *	<0.0075 * (avg.)
2	Cable Pull (approx. 30 min.)	<0.008 *	
3	Splicing (approx. 30 min.)	0.045	<0.020 (avg.)
4	Splicing (approx. 30 min.)	<0.008 *	
4 ext.	Splicing extension (approx. 20 min.)	<0.007 *	
	Entire Testing Day (approx. 5 hrs.)	0.013	
	Full-shift TWA	<0.008	
	OSHA Full-shift PEL	0.1	

* = No asbestos fibers detected in any of these samples.

Asbestos Concentrations at Stationary Sites

Table II presents the results of air monitoring for asbestos fibers at the eight stationary sampling sites. Examination of these general area sampling results reveals that asbestos fiber concentrations did not vary significantly throughout the test room; the overall average concentrations for the sites was less than 0.009 fiber/cc, ranging from less than 0.0073 fiber/cc at Location A-7 to less than 0.0135 fiber/cc at Location A-2. Again, the combination of phase contrast and transmission electron microscopy showed that 1) the majority of "fibers" were not asbestos and 2) the only form of asbestos identified in any sample was chrysotile.

Table II
Results of General Area Monitoring for Asbestos
During Tests with U.S.Steel Asbestos-Containing Tiger Brand Electrical Cable

Sample Location	Test 1 asbestos fiber/cc	Test 2 asbestos fiber/cc	Test 3 asbestos fiber/cc	Test 4 asbestos fiber/cc	Average asbestos fiber/cc
General area, A-1	<0.002 *	<0.002 *	<0.001 *	0.025	<0.0075
General area, A-2	<0.001 *	<0.002 *	0.014	0.037	<0.0135
General area, A-3	<0.002 *	<0.002 *	0.002	0.025	<0.0078
General area, A-4	0.002	<0.002 *	0.020	0.009	<0.0083
General area, A-5	<0.002 *	<0.002 *	0.007	0.024	<0.0088
General area, A-6	<0.002 *	<0.002 *	<0.003 *	0.034	<0.0103
General area, A-7	<0.002 *	<0.002 *	<0.003 *	0.022	<0.0073
General area, A-8 (#)	0.001				

Â-x = general area sampling locations, keyed to Figure 1

\# = this sample was allowed to run for the entire period of testing, approximately 5 hours

* = No asbestos fibers were detected in any of these samples.

Concentrations of Total Fibers

Table III summarizes the results of the tests in terms of total fibers per cubic centimeter, based on the phase contrast microscopy method alone, i.e., without specific identification of fibers. These data show that even if all fibers were considered in calculating the fiber concentrations, the resulting exposure of the electrician would still be below all past and current acceptable limits; his calculated time-weighted average exposure for the full 8-hour day was 0.026 fiber/cc, four times lower than the current OSHA permissible asbestos exposure limit. Of significance, these latter calculations include all fibers and, as reported earlier, most of the "fibers" were determined by transmission electron microscopy not to be asbestos.

Table III
PCM Results of Air Monitoring for Total Fibers
During Tests with U.S.Steel Asbestos-Containing Tiger Brand Electrical Cable

Sample Location	Test 1 total fiber/cc	Test 2 total fiber/cc	Test 3 total fiber/cc	Test 4 ⊕ total fiber/cc	Entire Test total fiber/cc
Personal breathing zone of electrician	0.033	0.104	0.066	0.073 ⊕ <0.011, Test 4 Extension	0.041
General area, A-1	0.019	0.032	0.031	0.037	-
General area, A-2	0.029	0.040	0.043	0.058	-
General area, A-3	0.036	0.041	0.027	0.038	-
General area, A-4	0.035	0.040	0.039	0.051	-
General area, A-5	0.034	0.042	0.017	0.061	-
General area, A-6	0.039	0.032	0.019	0.039	-
General area, A-7	0.020	0.050	0.027	0.035	-
General area, A-8	-	-	-	-	0.016

A-x = general area sampling locations, keyed to Figure 1
⊕ = personal sample was changed at approximately 30 minutes; all others were allowed to run to the completion of the tests and consumption of the electrical cable

CONCLUSIONS

The following conclusions are based on the monitoring and observations obtained during the tests reported herein.

1. Exposures of persons to asbestos while performing typical electrician's tasks with U.S.Steel Tiger Brand asbestos-containing electrical wire/cable would be well below current recommended exposure limits, including the permissible exposure limits established by the Occupational Safety and Health Administration (OSHA) and the threshold limit values recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).

2. Given the documented low exposures of the electrician during typical activities, as well as the area monitoring results, persons in the vicinity of an electrician working with U.S.Steel Tiger Brand asbestos-containing electrical wire/cable would be exposed to airborne concentrations of asbestos well below current recommended exposure limits.

3. Since the exposure of workers to asbestos as a result of using U.S.Steel's Tiger Brand asbestos-containing electrical wire/cable is below current acceptable limits and, since the current OSHA permissible exposure limits are the most stringent in occupational health history, workers' exposures to asbestos while performing typical electrician activities have always been well below acceptable limits.

4. Since there is, and has been, no reason to anticipate release of significant amounts of any contaminant, including asbestos, from U.S.Steel Tiger Brand asbestos-containing electrical wire/cable during typical intended applications, there would have been no credible basis for requiring U.S.Steel to issue cautionary labels or other forms of warning with these products.

SUMMARY OPINION

It is the opinion of the undersigned that, to a degree of reasonable scientific certainty, exposures of workers to airborne asbestos resulting from typical handling and use of U.S.Steel's Tiger Brand asbestos-containing electrical wire and cable historically have been well below acceptable exposure limits. Therefore, such activities and resultant exposures are not, and have not been, considered to represent a potential hazard to the health of the workers.

This report prepared by: Robert D. Soule, CIH, CSP and John B. Masaitis, CIH