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**FIBER RELEASE STUDY
MARITIME FITTINGS
VALVE PACKING REMOVAL
AND REPLACEMENT**

December 24, 1996
BAI Project #1418A-4602

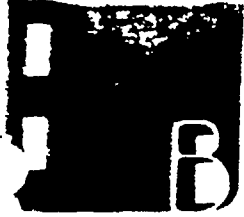


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**FIBER RELEASE STUDY
MARITIME FITTINGS
VALVE PACKING REMOVAL
AND REPLACEMENT**

EXECUTIVE SUMMARY

Objectives

The purpose of the study was to determine the concentration of fibers in the air while packing material was removed and replaced in valves.

Background

The study was performed using intact valves from maritime fittings. The fittings had been in service many years and were obtained from three (3) decommissioned US war ships.

The study was conducted in an isolation chamber to eliminate outside influences. The study was conducted at the rate of one (1) fitting per hour over an 8-hour period.

The study was conducted on December 20, 1996 by Mr. Fred Boelter. This report presents the results of the study described herein.

Sample Results

All samples measured concentrations of fibers in air well below the U.S. Department of Labor Occupational Safety and Health Administration (USDOL-OSHA) 8-hour Time-Weighted Average (TWA) Permissible Exposure Limit (PEL) of 0.1 fibers per cubic centimeter (f/cc). Sample results are presented in the accompanying tables.



METHODOLOGY

PCM Sampling Procedure

Samples were collected and analyzed following NIOSH Method 7400. Air was drawn through a 25mm, conductive cowl cassette with a 0.8 micron mixed cellulose ester (MCE) filter for collecting airborne particulate. The cassette was connected to a dedicated Gilian servo-drive pump. The pump was used to maintain a flow rate of two (2) liters per minute (lpm) for both personal and area room air samples.

A Brooks rotameter was used to calibrate the pumps prior to and post sample collection. The rotameter was calibrated against a primary standard.

The samples were sealed, labeled and shipped to the laboratory for analysis. Samples were signed by BEC, placed in a UPS shipping envelope, sealed, tracked by UPS, and arrived at the laboratory by next day air.

Personal Samples

Personal samples were collected by attaching the cassette in the breathing zone of the individual performing the work for the duration of the test. The sampling pump was worn on the individual's belt.

Average Room Air Samples

The isolation chamber was subdivided into 3,800 one cubic foot (1ft³) modules. For purposes of identification, each module was assigned a discrete, consecutive number.

To determine the average room air concentration, eight (8) of the modules were selected using a random number generator. A sample cassette was located in the center of the respective module for the duration of the test.

Background Air Samples for TEM Analysis

Prior to conducting the test, the room was sampled to verify cleanliness. Five (5) samples were analyzed by transmission electron microscopy (TEM) following AHERA Protocol.

Just prior to collecting the samples, a "leaf blower" was utilized to aggressively disturb the isolation chamber's interior surfaces.

Air was drawn through a 25mm, conductive cowl cassette with a 0.8 micron mixed cellulose ester (MCE) filter for collecting airborne fibers. The cassette was connected to a dedicated Gast high volume pump. The pump was used to maintain a flow rate of 10 liters per minute (lpm).

A BGI rotameter was used to calibrate the pumps prior to and post sample collection. The rotameter was calibrated against a primary standard.



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The samples were sealed, labeled and shipped to the laboratory for analysis. Samples were signed by BEC, placed in a UPS shipping envelope, sealed, tracked by UPS, and arrived at the laboratory by next day air.

Background Air Samples for PCM Analysis

Simultaneous with collecting the five (5) samples for analysis by AHERA Protocol, three (3) additional air samples were collected in accordance with NIOSH 7400 for PCM analysis "on-site" in the BEC office. The same analytical procedures were followed in the BEC office as were used in the laboratory. An Olympus Model CH-2 phase contrast microscope was used for the BEC analyses.

Light Microscopy Analysis

Samples were analyzed in accordance with NIOSH Method 7400. Total fiber counts were determined by phase contrast microscopy (PCM) in accordance with the NIOSH Manual of Analytical Methods, Fourth Edition, dated 8/15/94, A Rules. Values for PCM analysis are provided in the Appendix A and Appendix B spreadsheets.

Only fibers longer than 5 microns which have a length to width ratio equal to or greater than 3:1 are counted. PCM analysis counts all fibers meeting the specified dimensions. The analysis is not specific for asbestos but is the method specified to be used in the OSHA regulations.

The PCM laboratory reports are presented in Appendix C.

Electron Microscopy Analysis

AHERA Protocol transmission electron microscopy (TEM) analysis was performed on all background samples to verify the cleanliness of the isolation chamber prior to beginning the test. The sample analysis was performed as described in the Federal Register Vol. 52, No. 210, the Asbestos Hazard Emergency Response Act (AHERA Protocol).

Small squares were cut from each filter, processed appropriately, placed onto 200 mesh copper screens (grids) and transferred to a modified Jaffe Wick Washer containing acetone solvent. After the appropriate processing time, the grids were examined with a JEOL 1200EX or 100CX TEM. Grid openings from each sample were scanned at 20,000X.

When fibers or structures of various shapes were encountered, they were assessed for morphological characteristics and crystalline structure with selected area electron diffraction (SAED).

The TEM laboratory reports are presented in Appendix D.

Statistical Comparisons

Data was formatted in spreadsheets for analysis. Statistical functions were performed including maximum, average, minimum, standard deviation, and variance.



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The spreadsheets in Appendices A and B present the data and summarize the statistical analyses performed.

Laboratory Accreditation

The samples were shipped to and analyzed by R. J. Lee Group, Inc. in their Monroeville, Pennsylvania laboratory. R. J. Lee is accredited for TEM analysis by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP) as Lab #101208. R. J. Lee is also accredited for PCM analysis by the American Industrial Hygiene Association (AIHA) as Lab #8204.



DISCUSSION OF FINDINGS

Isolation Test Chamber

Testing was performed in the Boelter Environmental Consultants' (BEC's) Isolation Test Chamber. The chamber is 20 feet wide by 20 feet deep and is 9 feet in height. The chamber was constructed of 6 mil polyethylene sheeting to physically separate the activity being tested from outside of the chamber influences. The chamber is shown in Figure 1.

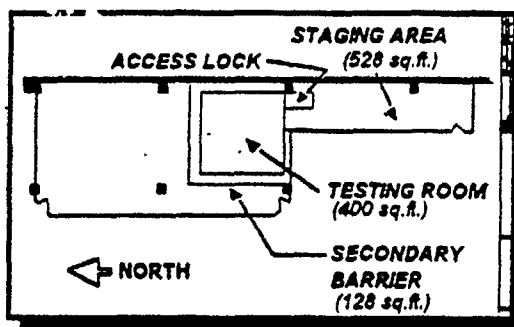


FIGURE 1 - BEC Isolation Test Chamber

The chamber was a static environment. During the test, there was no air movement into the chamber and there was no air movement out of the chamber. During cleaning, the room was ventilated with HEPA filtered air. Entry into the chamber was only through an access airlock.

Background Sampling Results

Prior to conducting any tests, the isolation chamber was systematically cleaned. Following the cleaning, a series of background samples were analyzed from five (5) area sampling locations in accordance with AHERA protocol.

Background samples were collected under "aggressive" conditions with analysis by TEM in accordance with AHERA Protocol.

Results of the Pre-Test Background sampling are shown in the following table:

STATISTICAL FUNCTION	Aggressive Air TEM (s/mm ²) - Background -
MAXIMUM	8.4
AVERAGE	8.4
MINIMUM	8.4
STAND. DEV.	0.0
VARIANCE	0.0
COUNT	5

The levels met the AHERA Clearance Criteria of an average of less than seventy structures per millimeter squared (<70 s/mm²) for the 5 samples and the room was considered clean. Results are shown in the spreadsheet presented in Appendix B.

Selection of Fittings

Eight (8) fittings were selected for the valve packing removal and replacement test. Fittings which were selected for the test were as shown in the following table:



TABLE I - FITTINGS SELECTED				
HOUR	FITTING NUMBER	SHAFT DIAMETER (in.)	PACKING DIAMETER (in.)	PACKING DEPTH (in.)
1	43	1 3/16	1 7/8	1 14/16
2	40	9/16	1 3/16	5/16
3	41	3/4	1 1/2	3/4
4	50	7/8	1 5/8	3/4
5	47	1 1/4	1 7/8	1 3/4
6	49	13/16	1 7/16	1 1/8
7	63	1 5/8	2 5/8	1 1/2
8	62	1 1/4	1 7/8	1 1/4

All fittings were obtained from three (3) decommissioned US war ships.¹ All fittings were carefully cleaned prior to being used in the test.²

Valve Packing Removal and Replacement Test Method

A work bench and hoist was placed in the center of the test chamber. The eight (8) fittings selected for the test (See Table I) were all placed in the isolation chamber.

Personal and average room air samplers were started prior to beginning the testing. The samplers were stopped after completion of the testing.

Testing started at about 8:00am and was concluded at about 5:00pm ("test cycle"). There was about a one hour break starting at about 12 noon. During the testing, no one left or entered the isolation chamber.

Each hour during the test cycle, one of the eight fittings was positioned in the center of the room on the work bench ("cycle event"). A typical setup for an event cycle is shown in Photo 1.

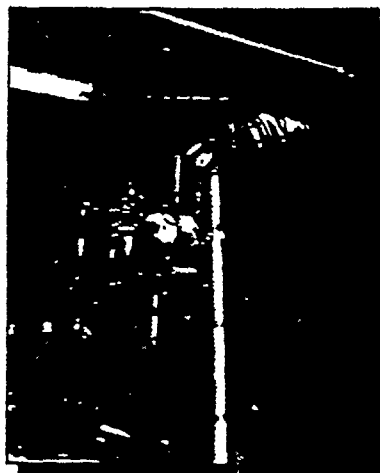


PHOTO 1 - Test setup for Valve Packing Removal and Replacement. Fitting placed on work bench.

¹ The three (3) decommissioned US war ships were the USS Davis, USS Ricketts or USS King.

² The fittings were carefully blasted with glass beads to remove surface corrosion, rust, paint, insulation, etc. The gaskets were left intact. A light coat of clear lacquer was spray applied to the fitting after cleaning to prevent rusting. The edge of the flange was masked off during spraying to protect the gasket. If not removed, the surface corrosion, rust, paint, and insulation would have interfered with the analysis.



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Each of the eight cycle events were essentially the same. During the hourly cycle event, similar procedures were followed as described in Table II:

TABLE II - TYPICAL HOURLY CYCLE EVENT		
STEP	ACTIVITY	PHOTO
1	Place fitting on work bench	1
2	Remove compression ring	2
3	Using corkscrew packing tool to remove packing material	3
4	Using pick to remove packing material	4
5	Cutting the replacement valve packing material	5
6	Replacing the valve packing material	6
7	Replacement of head bolts and compression ring	7

Thumbnail photographs depicting the various steps described in Table II follow below. Full size photographs are presented in Appendix E.



PHOTO 2 - Removing compression ring. Fitting #40 is shown.

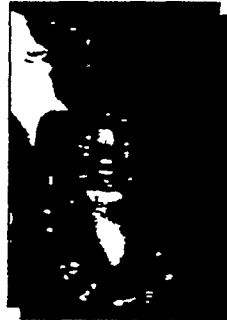


PHOTO 3 - Removing packing material. Fitting #62 is shown.



PHOTO 4 - Removing packing material. Fitting #49 is shown.



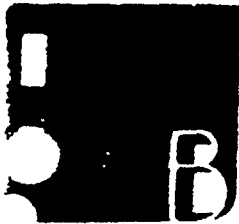
PHOTO 5 - Cutting packing material. Fitting #47 is shown.



PHOTO 6 - Replacing of packing. Fitting #41 is shown.



PHOTO 7 - Replacing bolts. Fitting #49 is shown.



Sampling Results During Test

Results of 8-Hour Time-Weighted Average Permissible Exposure Limit sampling are:

STATISTICAL FUNCTION	PCM Analysis by NIOSH 7400 (Total f/cc)	
	- Personal Samples -	- Average Room Air -
MAXIMUM	0.010	0.011
AVERAGE	0.009	0.008
MINIMUM	0.008	0.004
STAND. DEV.	0.001	0.002
VARIANCE	0.000	0.000
COUNT	2	8

All sample results show the concentrations to be well below the current OSHA Permissible Exposure Limit of 0.1 f/cc as sampled over an 8-hour time-weighted average period of time. Refer also to Figure 2 for a graphical presentation of the air sample results.

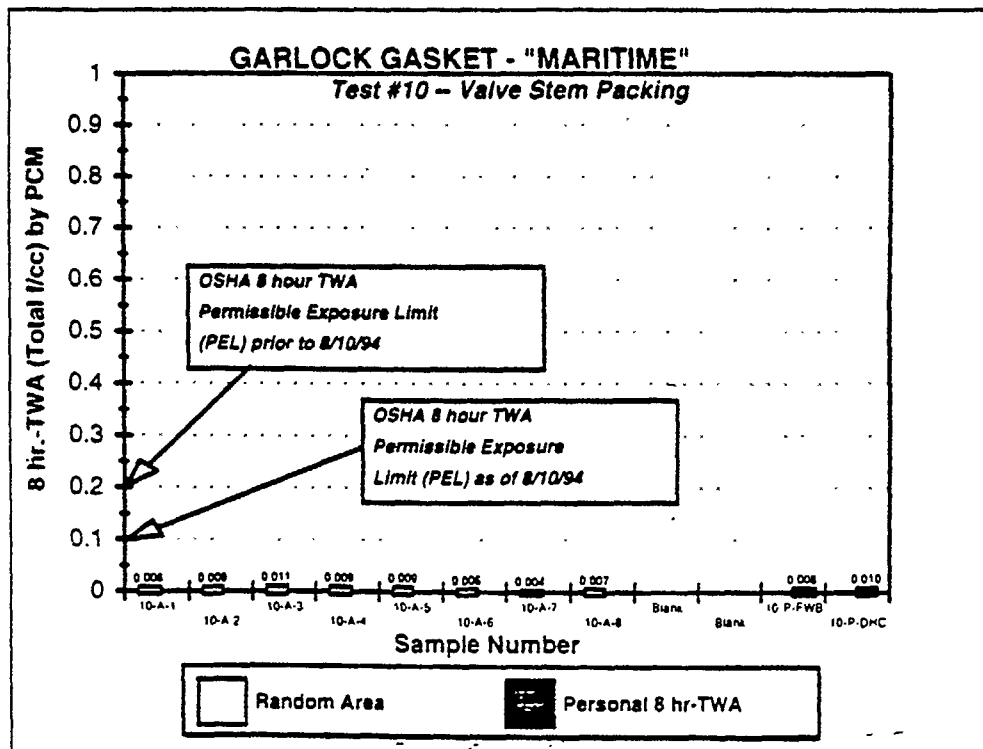


Figure 2 - Graphical presentation of the air sample results.

The Appendix A spreadsheets and charts present and depict the results of the testing in detail.



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CONCLUSIONS

Packing material was removed from valves at the rate of one (1) per hour. Eight (8) room air samples and two (2) personal samples were collected during the processing.

All sample results show the airborne concentrations of fibers to be well below the current OSHA Permissible Exposure Limit of 0.1 f/cc as sampled over an 8-hour time-weighted average period of time.

Respectfully submitted,

BOELTER ENVIRONMENTAL CONSULTANTS

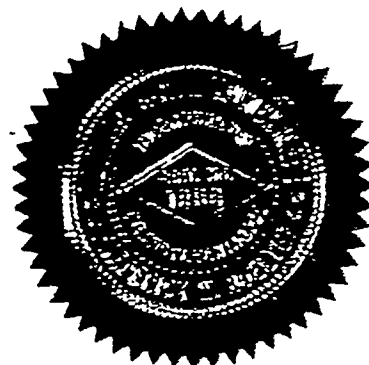
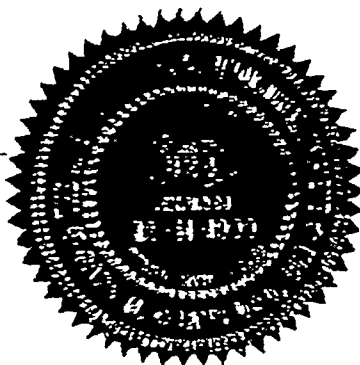
Frederick W. Boelter, CIH, PE, DEE, QEP

Reviewed by,

Gary N. Crawford, CIH

Enclosures

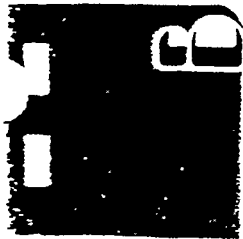
F:\APPS\WP5\EXPERT-W\1418XXXX\4602\REPORTS\14184602.MVP





APPENDIX A

**Compilation Spreadsheets and Graphs
TESTING RESULTS**



MARITIME FITTING TEST RESULTS
Cotec Industries/Garlock Packing
BAI Project #1418A-4602

Privileged & Confidential
Attorney Work Product

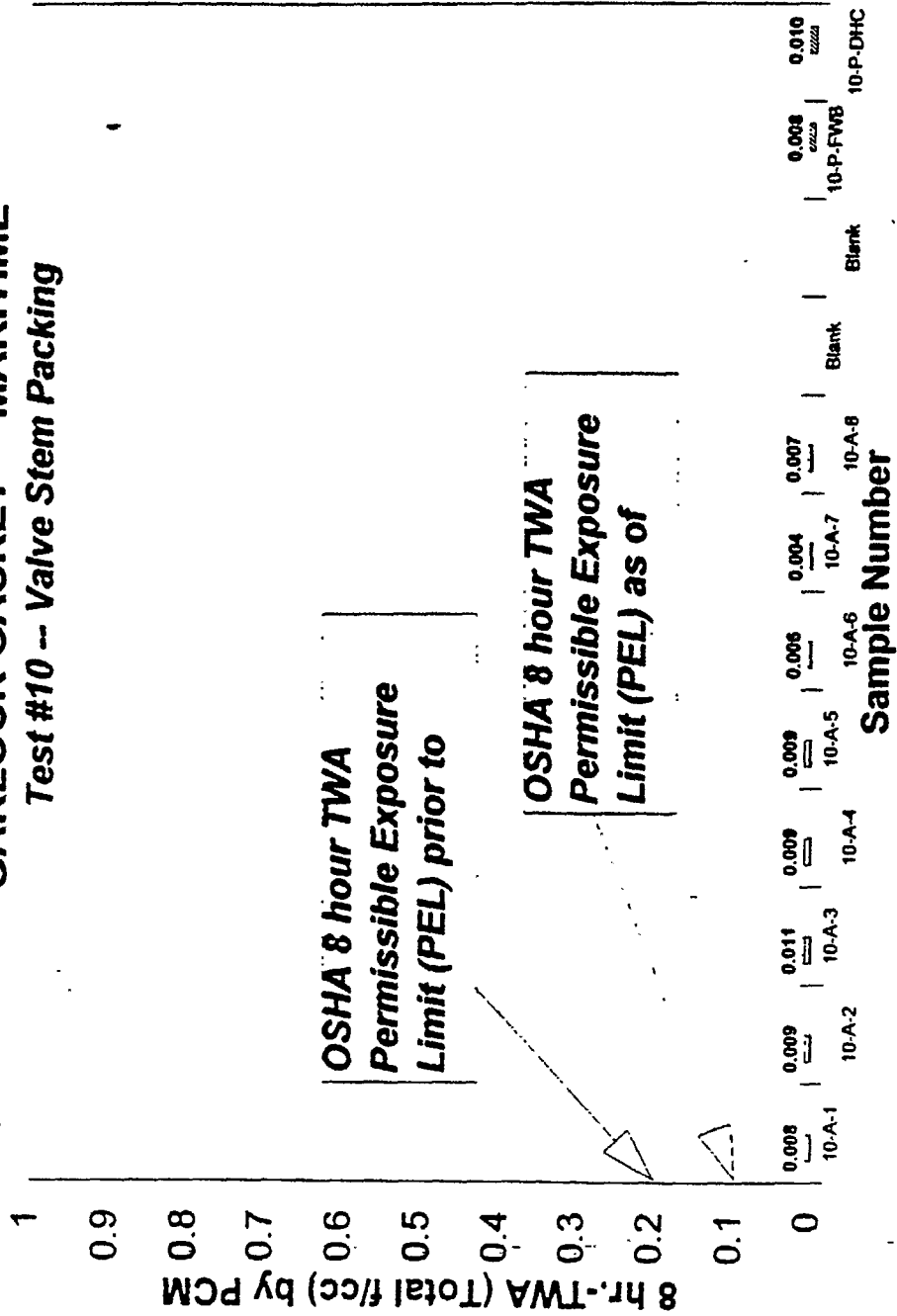
TEST	TEST DATE	SAMPLE NUMBER	SAMPLE TYPE	RANDOM AREA NUMBER	RANDOM AREA LOCATION	West	High	SAMPLE TIME	SAMPLE RATE	SAMPLE VOLUME	TESTING
Valve Packing	December 20, 1996	10-A-1	RANDOM AREA	1221	7	1	8	530	2	1060	0.008
Valve Packing	December 20, 1996	10-A-2	RANDOM AREA	972	6	12	4	530	2	1060	0.009
Valve Packing	December 20, 1996	10-A-3	RANDOM AREA	2767	16	7	4	530	2	1060	0.011
Valve Packing	December 20, 1996	10-A-4	RANDOM AREA	585	4	5	3	530	2	1060	0.009
Valve Packing	December 20, 1996	10-A-5	RANDOM AREA	2000	12	20	1	530	2	1060	0.009
Valve Packing	December 20, 1996	10-A-6	RANDOM AREA	2142	12	2	9	530	2	1060	0.006
Valve Packing	December 20, 1996	10-A-7	RANDOM AREA	1835	11	15	2	530	2	1060	0.004
Valve Packing	December 20, 1996	10-A-8	RANDOM AREA	242	2	2	4	530	2	1060	0.007
Valve Packing	December 20, 1996	10-A-9	BLANK					0	0	0	
Valve Packing	December 20, 1996	10-A-10	BLANK					0	0	0	
Valve Packing	December 20, 1996	10-P-FWB	PERSONAL-TWA					459	2	916	0.008
Valve Packing	December 20, 1996	10-P-DHC	PERSONAL-TWA					459	2	916	0.010

MAXIMUM
AVERAGE
MINIMUM
STAND DEV.
VARIANCE
COUNT

0.010
0.009
0.008
0.001
0.000
2
8

GARLOCK GASKET - "MARITIME"

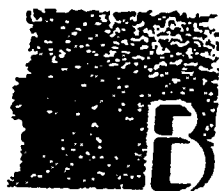
Test #10 -- Valve Stem Packing



Sample Number

Random Area

Personal 8 hr-TWA



APPENDIX B

**Compilation Spreadsheets and Graphs
PRE-TEST BACKGROUND RESULTS**

PRE-ACTIVITY BACKGROUND TESTING RESULTS

Collec Industries/Garlock Packing

BAI Project #1418A-4600

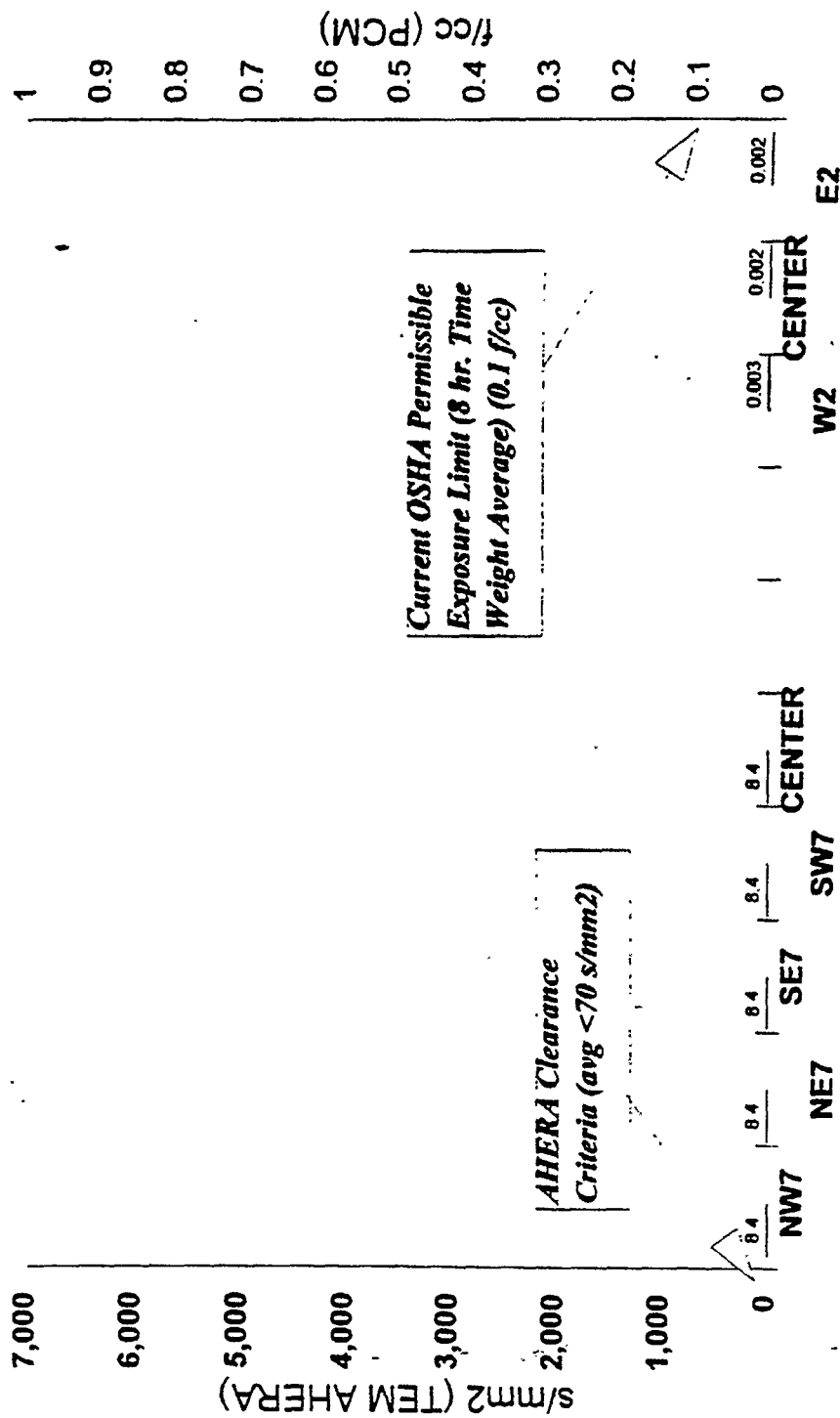
TEST NUMBER	TEST DATE	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE LOCATION	SAMPLE TIME	SAMPLE RATE	SAMPLE VOLUME	AGGRESSIVE AIR TEM RESULTS (Total Asbestos s/mm2) (avg <70 s/mm2)	LESS THAN LIMIT OF ANALYTICAL SENSITIVITY (<16.8 s/mm2)
10 18-Dec-96		10-B-1	AREA	NW7	130	10	1300	8.4	16.8
10 18-Dec-96		10-B-2	AREA	NE7	130	10	1300	8.4	16.8
10 18-Dec-96		10-B-3	AREA	SE7	130	10	1300	8.4	16.8
10 18-Dec-96		10-B-4	AREA	SW7	130	10	1300	8.4	16.8
10 18-Dec-96		10-B-5	AREA	CENTER	130	10	1300	8.4	16.8
10 18-Dec-96		10-B-6	BLANK						
10 18-Dec-96		10-B-7	BLANK						

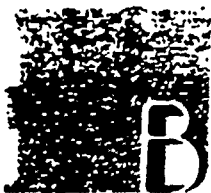
MAXIMUM
AVERAGE
MINIMUM
STAND DEV
VARIANCE
COUNT

8.4
8.4
8.4
0.0
0.0
5

BACKGROUND TESTS - Dec 18, 1996

BAI Project 1418A-4600





APPENDIX C

PCM Laboratory Reports

Test Report

Total Fiber Concentrations

PCM Air Analysis

Project AOH612854

Sample Number	Client Sample Number	Analyzed Area (sq. mm)	Volume (Liters)	Fibers	Fields	Concentration (fibers/sq. mm)	Concentration† (fibers/cc)	95% Upper Confidence Interval‡	Limit of Quantification‡	Analyst	Analysis Date
0567753BHPC	10-A-1	0.785	1060	17.5	100	22.2930	0.0001	0.0122	0.0025	RFW	12/24/96
0567754BHPC	10-A-2	0.785	1060	18.5	100	23.5669	0.0086	0.0129	0.0025	RFW	12/24/96
0567755BHPC	10-A-3	0.785	1060	23	100	29.2994	0.0106	0.0157	0.0025	RFW	12/24/96
0567756BHPC	10-A-4	0.785	1060	20	100	25.4777	0.0093	0.0138	0.0025	RFW	12/24/96
0567757BHPC	10-A-5	0.785	1060	20	100	25.4777	0.0093	0.0138	0.0025	RFW	12/24/96
0567758BHPC	10-A-6	0.785	1060	12	100	15.2866	0.0056	0.0088	0.0025	RFW	12/24/96
0567759BHPC	10-A-7	0.785	1060	7.5	100	9.5341	0.0035	0.0058	0.0025	RFW	12/24/96
0567760BHPC	10-A-8	0.785	1060	14.5	100	18.4713	0.0067	0.0104	0.0025	RFW	12/24/96
0567761BHPC	10-A-9	0.785	Blank	0	100	<7.0064*				RFW	12/24/96
0567762BHPC	10-A-10	0.785	Blank	0	100	<7.0064*				RFW	12/24/96
0567763BHPC	10-P-FWB	0.785	918	14.5	100	18.4713	0.0077	0.0120	0.0029	RFW	12/24/96
0567764BHPC	10-P-DHC	0.785	918	18	100	22.9299	0.0056	0.0145	0.0029	RFW	12/24/96

Samples received on: Monday, December 23, 1996

† Analytical results based upon the volumes provided by Boelter Environmental Consultants

Prepared, Counted, and Calculated in accordance with NIOSH 7400. Fiber counts and concentrations are blank corrected.

* Results Below Analytical Sensitivity

§ Sample is a Blank, or no volume was supplied. Calculation could not be done.

Authorized Signature

Robert F. Wellman

Robert F. Wellman, Microscopist

Date Tuesday, December 24, 1996

RJ Lee Group, Inc.
Headquarters

350 Hochberg Road
Monroeville, PA 15146

Phone (412) 325-1776
Fax (412) 733-1799

Page: 1 of 1



APPENDIX D

TEM Laboratory Reports

Test Report

Total Asbestos Structure Concentration

TEM AHERA Analysis

Project ATH612950

RJ Lee Group Sample Number	Client Sample Number	Filter Area (sq mm)	Volume† (Liters)	Area		Structures Chr Amp	Analytical Sensitivity ‡ (S/sq. mm)	Concentration		Analysis Date
				Analyzed (sq. mm)	Chr			(S/sq. mm)	(S/cc)	
00785801TT	10-B-1	385	1300.00	0.0596	0	0	16.8	0.0050	<16.8*	12/23/96
00785811TT	10-B-2	385	1300.00	0.0596	0	0	16.8	0.0050	<16.8*	12/23/96
00785821TT	10-B-3	385	1300.00	0.0596	0	0	16.8	0.0050	<16.8*	12/23/96
00785831TT	10-B-4	385	1300.00	0.0596	0	0	16.8	0.0050	<16.8*	12/23/96
00785841TT	10-B-5	385	1300.00	0.0596	0	0	16.8	0.0050	<16.8*	12/23/96
00785851TT	10-B-6	385	Blank	N/A	-	-	-	-	-	12/24/96
00785861TT	10-B-7	385	Blank	N/A	-	-	-	-	-	

† Volumes provided by Boelter Environmental Consultants for Project 1418A-4601 were used to calculate analytical results and sensitivities.

‡ Analytical sensitivity is the calculated concentration based on one structure in the area analyzed.

Samples received on Thursday, December 19, 1996

Chr - Chrysotile, Amp - Amphibole

* Results Less Than Analytical Sensitivity.

N/A - Sample not analyzed.

Authorized Signature

Kimberly A. Alligdon

Kimberly A. Alligdon, Manager-TIM Analysis

Date

Tuesday, December 24, 1996

RJ Lee Group, Inc.
Headquarters

350 Hochberg Road
Monroeville, PA 15146

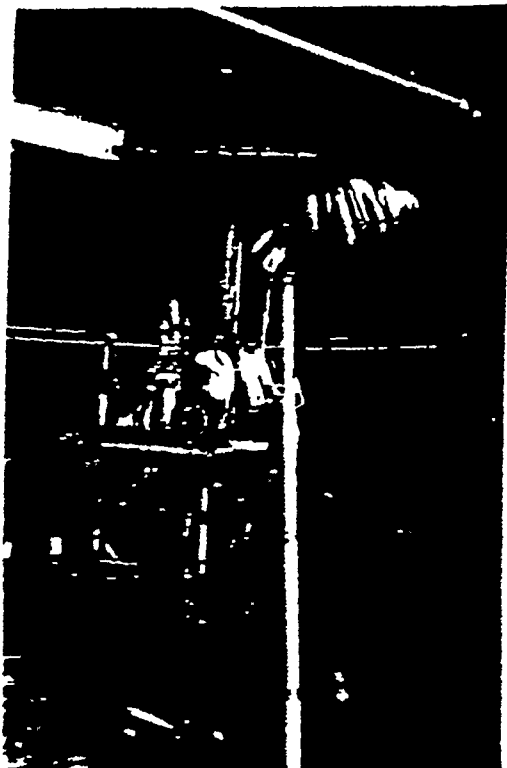
Test Report Page: 1 of 1

Phone (412) 325-1776
Fax (412) 733-1799



APPENDIX E

Original Photographs



-Photo 1-
Test setup for Valve Packing
Removal and Replacement.
Fitting is shown on work bench.



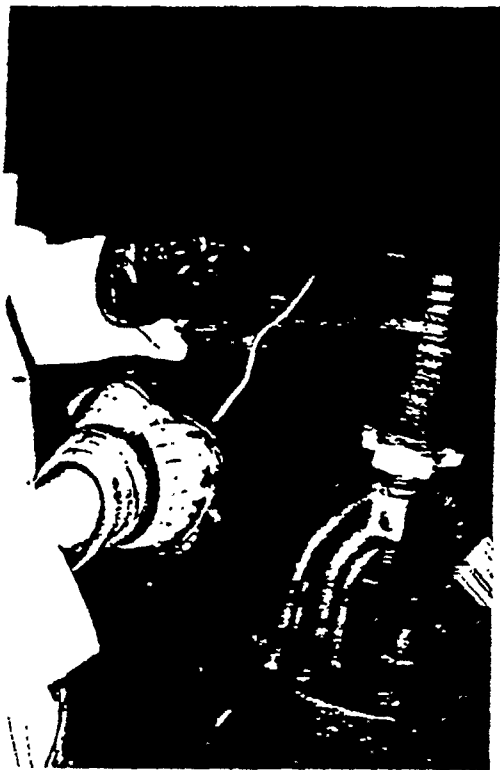
-Photo 2-
Removing compression ring.
Fitting #40 is shown.



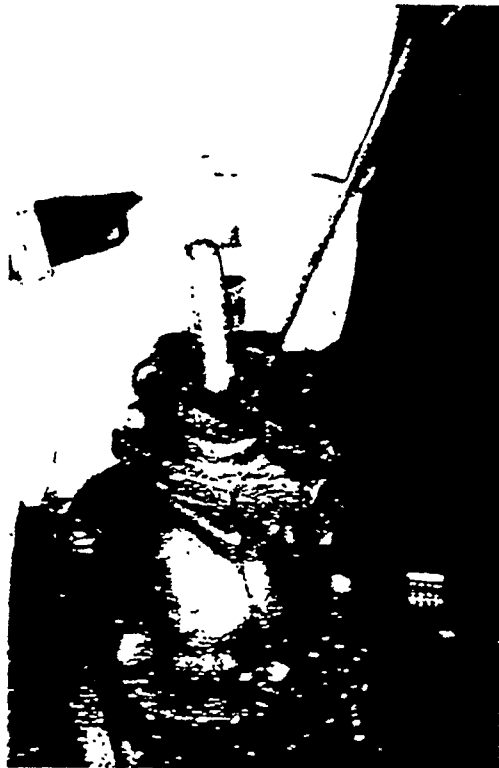
-Photo 3-
Using corkscrew packing tool to
remove packing material. Fitting
#62 is shown.



-Photo 4-
Using pick to remove packing
material. Fitting #49 is shown.



-Photo 5-
Cutting packing material. Fitting
#41 is shown.



-Photo 6-
Replacing the valve packing
material. Fitting #49 is shown.



-Photo 7-
Replacement of head bolts and
compression ring Fitting #49 is
shown.

COLLECTED PHOTO 104