

PLAINTIFF'S EXHIBIT

G-590



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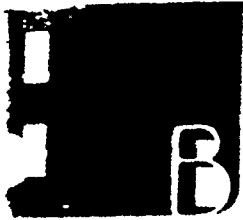
**FIBER RELEASE STUDY
MARITIME FITTINGS
MAKING GASKETS WITH
A BALL PEEN HAMMER**

December 18, 1996
BAI Project #1418A-4602



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FIBER RELEASE STUDY
MARITIME FITTINGS
MAKING GASKETS WITH A BALL PEEN HAMMER

EXECUTIVE SUMMARY

Objectives

The purpose of the study was to determine the concentration of fibers in the air while gaskets were made from stock material with a ball peen hammer.

Background

The study was performed using intact flanges from maritime fittings. The fittings and flanges 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) gasket per hour over an 8-hour period.

The study was conducted on December 16, 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 3,600 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 AMERA 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.



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 20,000 X.

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.

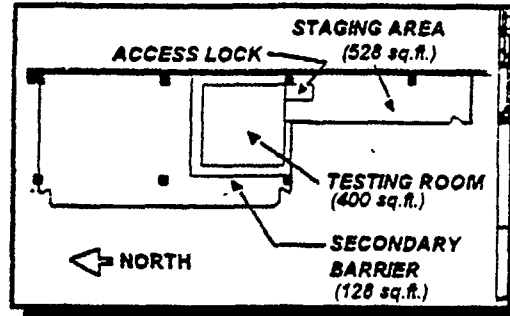


FIGURE 1 - BEC Isolation Test Chamber

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

Seven (7) fittings with a total of eight (8) flanges were selected for making gaskets with a ball peen hammer. Fittings which were selected for the test were as shown in the following table:



TABLE I - FITTINGS SELECTED					
HOUR	FITTING / FLANGE NUMBER	FLANGE DIAMETER (in.)	GASKET OUTSIDE DIAMETER (in.)	GASKET INSIDE DIAMETER (in.)	GASKET BOLT HOLE QUANTITY
1	42A	9	9	4 1/8	8
2	42B	9	9	3 15/16	8
3	53A	7 1/4	7 1/4	4	8
4	58A	6 1/8	6 1/8	2 13/16	6
5	57A	6 1/4	6 1/4	2 13/16	6
6	55A	3 7/8	3 7/8	7/8	4
7	56A	6 1/16	6 1/16	2 3/4	6
8	48C	7	7	4	8

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

Gasket Making 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 making of gaskets. Fitting placed on bench.

¹ The three (3) decommissioned US war ships were the USS Davis, USS Bicketts 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. The flanges used for gasket making had the original gaskets removed in prior tests. The flanges were cleaned prior to using them as a base for making gaskets.



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	Cutting of stock gasket material	2
3	Separate flange	3
4	Shaping of gasket material	4
5	Shaping of gasket material at bolt holes	5
6	Completed gasket	6
7	Tighten bolts to 60 ft. lb.	7

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



PHOTO 2 - Cutting gasket material.

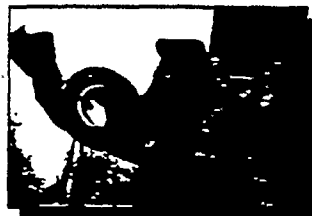


PHOTO 3 - Separate flange. Fitting #53 is shown.



PHOTO 4 - Shaping gasket. Fitting #57A is shown.



PHOTO 5 - "Facing" the flange. Fitting #42B is shown.



PHOTO 6 - Completed gasket. Fitting #55A is shown.



PHOTO 7 - Tighten bolts. Fitting #56 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	0.029	0.025
AVERAGE	0.026	0.021
MINIMUM	0.022	0.017
STAND DEV	0.003	0.003
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.

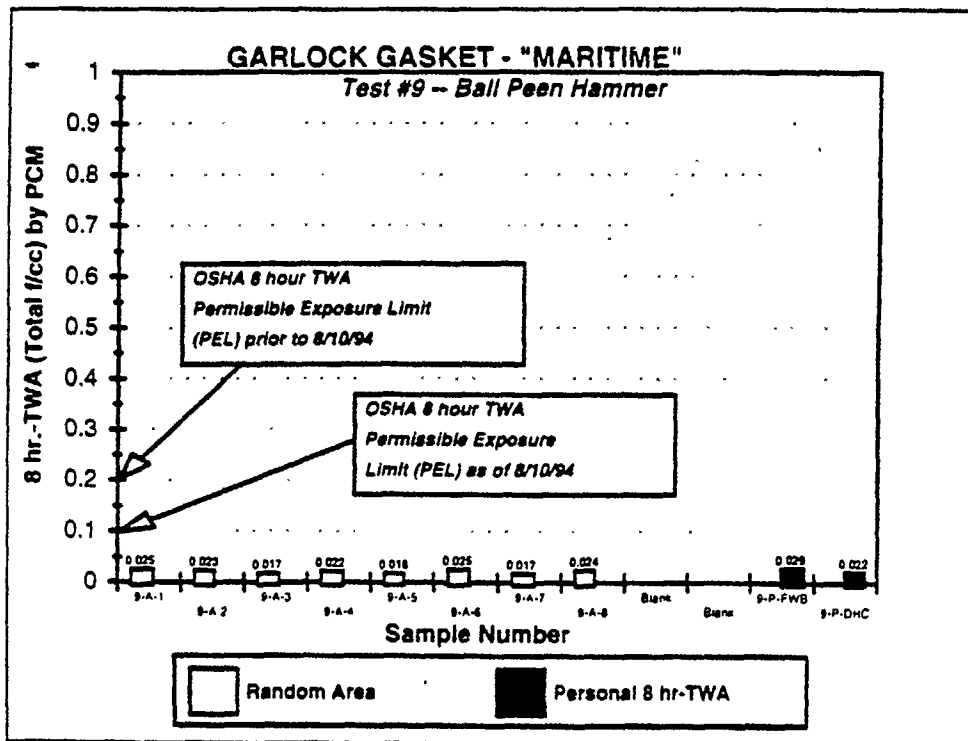


Figure 2 - Graphical presentation of the air sample results.

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



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CONCLUSIONS

Gaskets were made 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

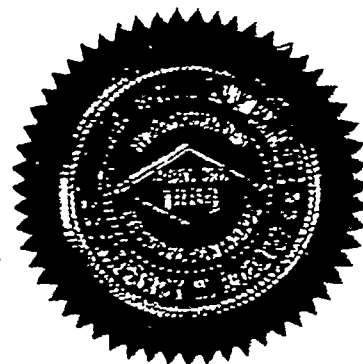
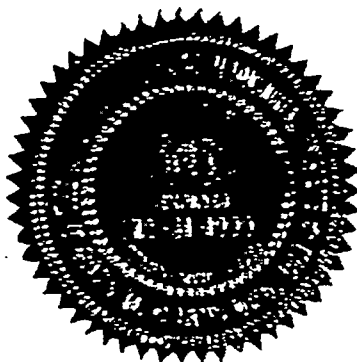
Frederick W. Boelter, CIH, PE, DEE, QEP

Reviewed by,

Gary N. Crawford, CIH

Enclosures

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APPENDIX A

**Compilation Spreadsheets and Graphs
TESTING RESULTS**



MARITIME FITTING TEST RESULTS
Coltec Industries/Garlock Packing
BAI Project #1418A-1602

Privileged & Confidential
Attorney Work Product

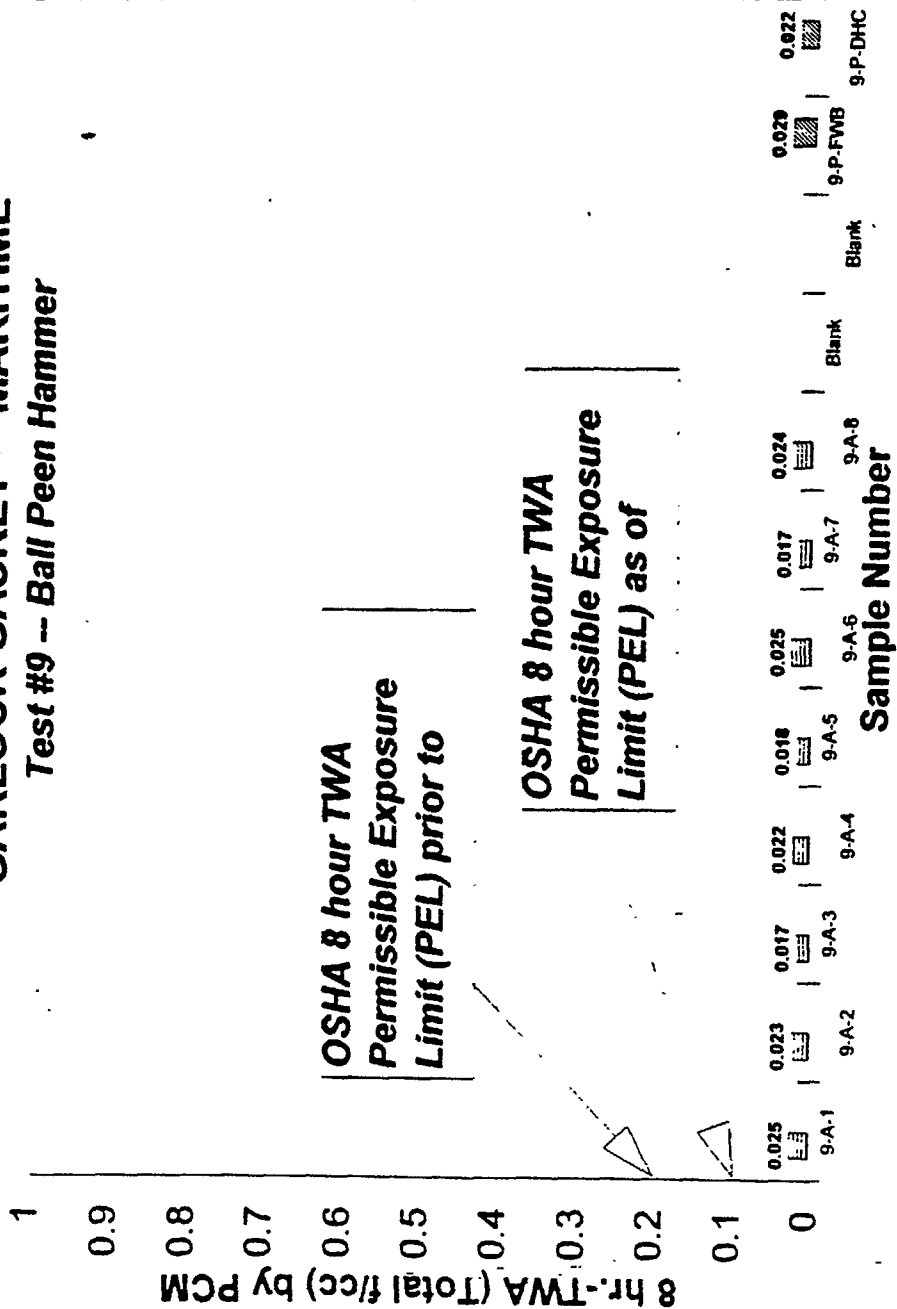
TEST	TEST DATE	SAMPLE NUMBER	SAMPLE TYPE	RANDOM AREA NUMBER	RANDOM AREA LOCATION	West	High	SAMPLE TIME	SAMPLE RATE	SAMPLE VOLUME	TESTING	PCM RESULTS (Total f/cc)	- Personal TWA -	- Area 2 -
Ball Peen	December 16, 1996	9-A-1	RANDOM AREA	2732	18	12	2	532	2	1084		0.025		
Ball Peen	December 16, 1996	9-A-2	RANDOM AREA	982	8	2	5	532	2	1084		0.023		
Ball Peen	December 16, 1996	9-A-3	RANDOM AREA	2529	15	9	1	532	2	1084		0.017		
Ball Peen	December 16, 1996	9-A-4	RANDOM AREA	2724	16	4	2	532	2	1064		0.022		
Ball Peen	December 16, 1996	9-A-5	RANDOM AREA	2041	12	1	4	532	2	1084		0.016		
Ball Peen	December 16, 1996	9-A-6	RANDOM AREA	765	5	5	3	532	2	1084		0.025		
Ball Peen	December 16, 1996	9-A-7	RANDOM AREA	1814	11	14	1	532	2	1084		0.017		
Ball Peen	December 16, 1996	9-A-8	RANDOM AREA	698	4	18	8	532	2	1084		0.024		
Ball Peen	December 16, 1996	9-A-9	BLANK					0	0	0				
Ball Peen	December 16, 1996	9-A-10	BLANK					0	0	0				
Ball Peen	December 16, 1996	9-P-FWB	PERSONAL-TWA					458	2	912		0.029		
Ball Peen	December 16, 1996	9-P-DHC	PERSONAL-TWA					458	2	912		0.022		

MAXIMUM
AVERAGE
MINIMUM
STAND DEV.
VARIANCE
COUNT

0.029
0.026
0.022
0.003
0.000
2
8

GARLOCK GASKET - "MARITIME"

Test #9 -- Ball Peen Hammer



Sample Number

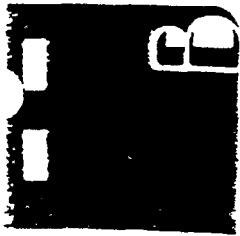
Random Area

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

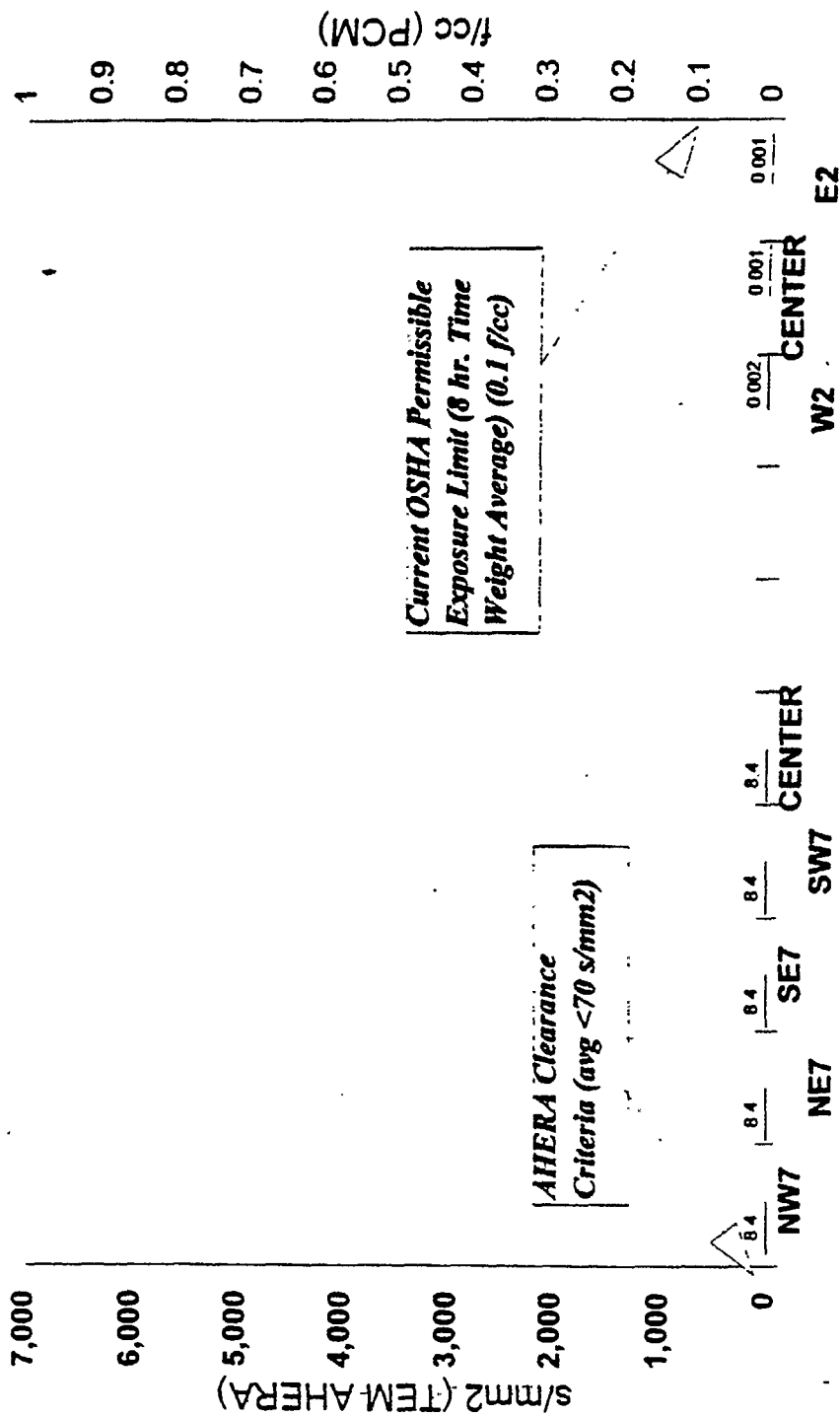
TEST NUMBER	TEST DATE	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE LOCATION	SAMPLE TIME	SAMPLE RATE	SAMPLE VOLUME	AGGRESSIVE AIR TEM RESULTS (Total Asbestos s/mm2) (avg <70 s/mm2)	LESS THAN LIMIT OF ANALYTICAL SENSITIVITY (<16.8 s/mm2)
9 12-Dec-96	9-B-1	9-B-1	AREA	NW7	130	10	1300	8.4	16.8
9 12-Dec-96	9-B-2	9-B-2	AREA	NE7	130	10	1300	8.4	16.8
9 12-Dec-96	9-B-3	9-B-3	AREA	SE7	130	10	1300	8.4	16.8
9 12-Dec-96	9-B-4	9-B-4	AREA	SW7	130	10	1300	8.4	16.8
9 12-Dec-96	9-B-5	9-B-5	AREA	CENTER	130	10	1300	8.4	16.8
9 12-Dec-96	9-B-6	9-B-6	BLANK						16.8
9 12-Dec-96	9-B-7	9-B-7	BLANK						16.8

MAXIMUM
AVERAGE
MINIMUM
STAND DEV
VARIANCE
COUNT

8.4
8.4
8.4
0.0
0.0
5

BACKGROUND TESTS - Dec 12, 1996

BAI Project 1418A-4600



TEM AHERA (Aggressive) PCM 7400 (Aggressive)

Current OSHA Permissible Exposure Limit (8 hr. Time Weight Average) (0.1 f/cc)

AHERA Clearance Criteria (avg <70 s/mm2)



APPENDIX C

PCM Laboratory Reports

Test Report

Total Fiber Concentrations

PCM Air Analysis

Project AOH612814

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
0567333BHPC	9-A-1	0.785	1064	54.5	100	69.4268	0.0251	0.0351	0.0025	RFW	12/18/96
0567334BHPC	9-A-2	0.785	1064	50	100	63.6943	0.0230	0.0323	0.0025	RFW	12/18/96
0567335BHPC	9-A-3	0.785	1064	37.5	100	47.7707	0.0173	0.0246	0.0025	RFW	12/18/96
0567336BHPC	9-A-4	0.785	1064	47.5	100	60.5096	0.0219	0.0308	0.0025	RFW	12/18/96
0567337BHPC	9-A-5	0.785	1064	38	100	48.4076	0.0175	0.0249	0.0025	RFW	12/18/96
0567338BHPC	9-A-6	0.785	1064	54.5	100	69.4268	0.0251	0.0351	0.0025	RFW	12/18/96
0567339BHPC	9-A-7	0.785	1064	37	100	47.1338	0.0171	0.0243	0.0025	RFW	12/18/96
0567340BHPC	9-A-8	0.785	1064	52.5	100	66.8790	0.0242	0.0339	0.0025	RFW	12/18/96
0567341BHPC	9-A-9	0.785	Blank	0	100	<7.0064*	§	§	§	RFW	12/18/96
0567342BHPC	9-A-10	0.785	Blank	1	100	<7.0064*	§	§	§	RFW	12/18/96
0567343BHPC	9-P-FWB	0.785	912	53.5	100	68.1529	0.0288	0.0402	0.0030	RFW	12/18/96
0567344BHPC	9-P-DHC	0.785	912	41.5	100	52.8662	0.0223	0.0316	0.0030	RFW	12/18/96

Samples received on: Tuesday, December 17, 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
Wednesday, December 18, 1996

RJ Lee Group, Inc.
Headquarters

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Page: 1 of 1

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APPENDIX D

TEM Laboratory Reports

Test Report

Total Asbestos Structure Concentration

TEM AHERA Analysis

Project ATH612933

RJ Lee Group Sample Number	Client Sample Number	Filter Area (sq mm)	Volume† (Liters)	Area		Structures Chir Amp	Analytical Sensitivity † (S/sq. mm)	Concentration		Analysis Date
				Analyzed (sq. mm)	Chir			(S/sq. mm)	(S/cc)	
00783671HT	9-B-1	385	1300.00	0.0596	0	0	16.8	<16.8*	<0.0050*	12/18/96
00783681HT	9-B-2	385	1300.00	0.0596	0	0	16.8	<16.8*	<0.0050*	12/18/96
00783691HT	9-B-3	385	1300.00	0.0596	0	0	16.8	<16.8*	<0.0050*	12/18/96
00783701HT	9-B-4	385	1300.00	0.0596	0	0	16.8	<16.8*	<0.0050*	12/18/96
00783711HT	9-B-5	385	1300.00	0.0596	0	0	16.8	<16.8*	<0.0050*	12/18/96
00783721HT	9-B-6	385	Blank	N/A	-	-	-	-	-	-
00783731HT	9-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: Friday, December 13, 1996

Chir - Chrysotile, Amp - Amphibole

* Results Less Than Analytical Sensitivity.

N/A - Sample not analyzed

Authorized Signature

Kimberly A. Allison
 Kimberly A. Allison, Manager-TEM Analysis

Date

Wednesday, December 18, 1996

RJ Lee Group, Inc.
 Headquarters

350 Hochberg Road
 Monroeville, PA 15146

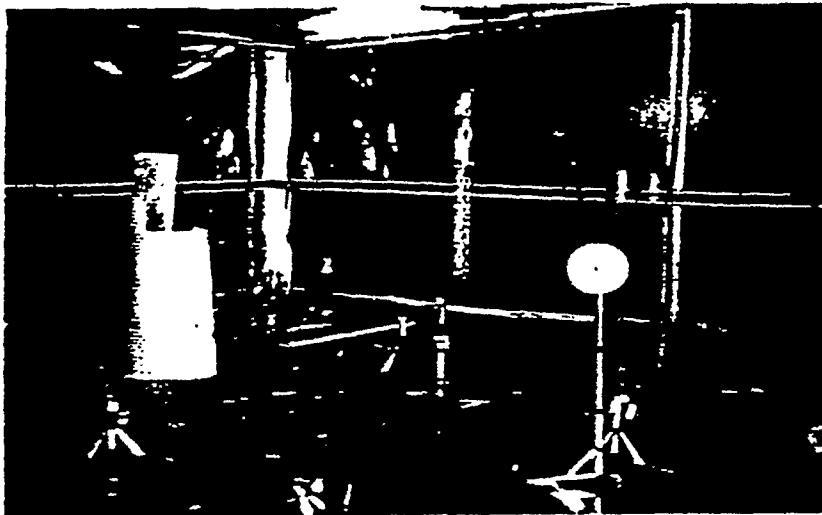
Test Report Page: 1 of 1

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

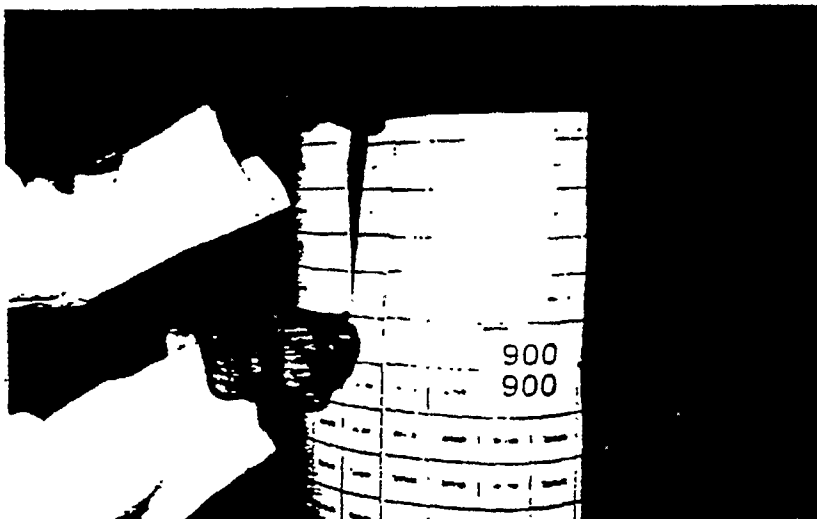


APPENDIX E

Original Photographs

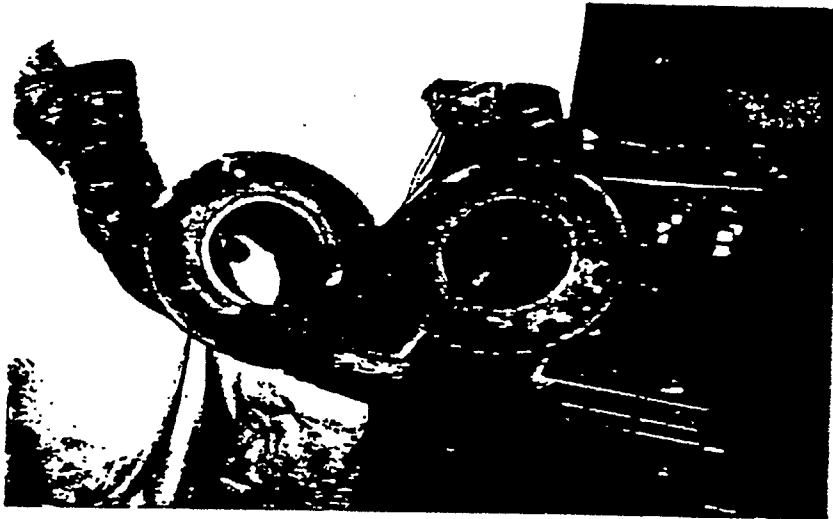


-Photo 1-
Test setup for making a gasket. Fitting is shown on the
work bench.

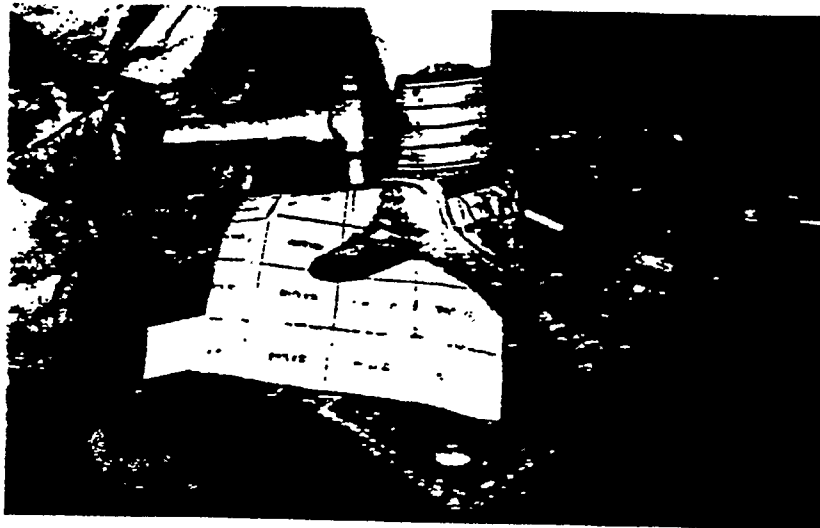


-Photo 2-
Cutting gasket material.

COLLECTED PHOTO 9P1

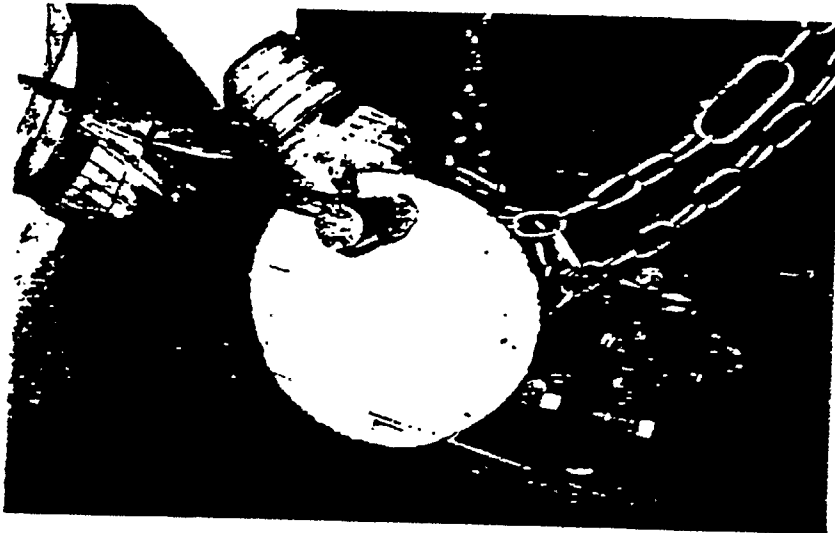


-Photo 3-
Separated flange. Fitting #53 is shown.

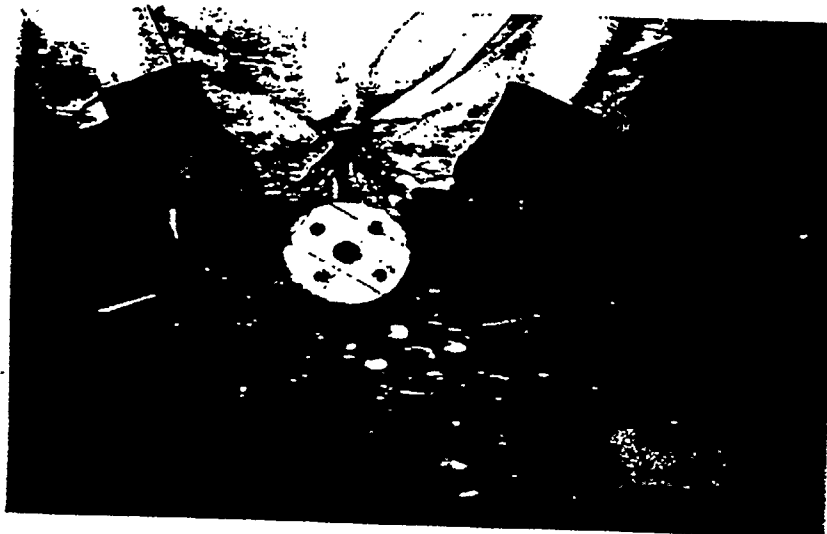


-Photo 4-
Shaping of gasket. Fitting #57A is shown.

© 2015 ECH PHOTO #P2



-Photo 5-
"Facing" the flange. Fitting #42B is shown.



-Photo 6-
Completed gasket. Fitting #55A is shown.

COLLECTED PHOTO 5P3



-Photo 7-
Tighten bolts. Fitting #56 is shown.

COLTED PH. PHOTO 694