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Report of Results: MVA0491

Asbestos Fiber Release During the Removal
of Valve Packing and Repacking

Prepared for:

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15 April 1993

PENGAD-Bayonne, N. J.
EXHIBIT
24

MVA0491



MVA, Inc.
Excellence in
Microanalysis

5500 Oakbrook Parkway #200
Norcross, Georgia 30093
404-662-8509

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of Valve Packing and Repacking

Prepared for:

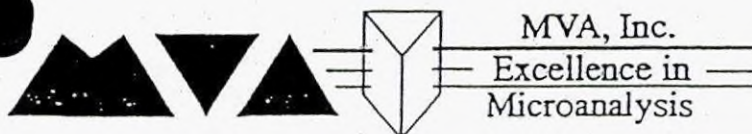
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**ASBESTOS FIBER RELEASE DURING
THE REMOVAL OF VALVE PACKING**

James R. Millette, Ph.D.
Steve M. Hays, CIH, PE
Michael D. Mount, OHST

Abstract

Asbestos packing material used in valves is generally considered to be a non-friable material unless cut or torn. In a controlled area personal and area air samples were collected before and during removal of asbestos packing material from a valve which had been used on board a ship. The results of this study show asbestos fibers can be released into the air during the generally used procedures for the removal of asbestos packing material. Air concentrations were measured by phase contrast microscopy to be 0.14 fibers/cc and by transmission electron microscopy in the range of 0.4 to 1.4 fibers/cc for asbestos fibers of all sizes.

Introduction

Most piping systems use valves to regulate the flow of liquids or gases within them. The valves, especially in industrial and maritime facilities, may contain asbestos packing material which acts as a seal to prevent fluid or gas leakage as the valve is turned. Periodically, the valves must be repaired or routinely maintained by removing the packing and replacing it with new packing.

Asbestos Packing Material

According to the U.S. Environmental Protection Agency (EPA), asbestos packing means an asbestos-containing product intended for use as a mechanical seal in circumstances involving rotary, reciprocating and helical motions, and which are intending to restrict fluid or gas leakage between moving and stationary surfaces. In a valve, the packing is compressed against the bore of the box by a gland which is tightened down on the packing. The packing is forced against the throat of the valve box and the packing conforms to the valve shaft surface forming a tight seal.

Compression packings are manufactured from various types of fibers, such as vegetable, animal, mineral (asbestos) or synthetic, twisted or braided with binders and lubricants. One of the most commonly used in valves is a graphite impregnated packing material which has the appearance of shiny, stiff rope. EPA states that products such as packing may release asbestos dust if cut or torn.

Study Design

Asbestos-containing materials are common on ships and because a maintenance activity often involves the disturbance of more than one material, it is difficult to assess the contribution, if any, of a particular ACM to the overall airborne asbestos concentration. Valve packing removal, for instance, may involve the removal or at least disturbance of asbestos-containing pipe insulation or fitting "mud". Therefore, to determine the possible contribution of valve packing only, special precautions were taken to isolate this material from other activities that might have contributed airborne asbestos from other sources.

Study Site

The study was conducted in a warehouse in Norcross, Georgia. An asbestos abatement type enclosure was built for the study to isolate the testing from any other source of asbestos and to prevent any fiber release from contaminating the building. The containment barriers in the area consisted of three layers of 6-mil polyethylene plastic sheets on a wooden frame and three layers of 6-mil polyethylene plastic on the floor. A containment area (8 ft by 8 ft) around the valve was completely contained within a larger containment area. The study area had two High Efficiency Particulate Absolute (HEPA) air filtration devices (AFD) used to clean the area of particulate including asbestos before the valve packing removal activity. In the outer area the AFD operated throughout the test.

Study Procedures

The study consisted of the collection of air samples before and during a valve packing removal activity. Prior to the study, the valve had been thoroughly washed and the flanges which contained gaskets were sealed with duct tape. A spray encapsulant was also used on the valve. The valve packing removal was performed by a retired

pipefitter using his own tools (Figure 1) and performing the removal of packing in the same way that he had in his previous years of work on valves. Although some lubricating oil was used to loosen the bolts on the valve, the work was generally done in a dry manner. One packing removal test was performed (Figures 2 through 5). Pieces of the removed packing were placed in plastic bags and stored for analysis. The packing removed from the valve appeared to be graphite impregnated packing material with a wire insert. It had a shiny gray-black appearance. The packing removal activity occurred for approximately 62 minutes. The study site was cleaned after the work. After the valve stuffing box had been cleaned thoroughly and vacuumed with a HEPA vacuum, the valve was repacked with an asbestos-containing packing (Figures 6 and 7). The repacking test period was 7 minutes.

Prior to starting the study, three (3) area air samples were collected to determine the background level of asbestos in the air of the study area. The sampling cassettes were located on the walls at the breathing zone, five feet from the floor. A volume of 1100 liters of air was passed through each cassette at a flow rate of 10 liters per minute. During the background sampling, the valve and area were swept vigorously with a broom. One (1) area air sample was collected during the valve packing removal in the same locations as one of the background air samples, approximately five feet from the gasket removal activity. It was collected at 5.0 lpm. The person doing the packing removal was fitted with two personal air sampling devices and a person helping and photographing the activity was fitted with one personal monitor. These personal air samples were collected at a rate of 2.2 liters per minute. Personal air samples were also collected on the person repacking the valve.

All personnel inside the study area were protected by air purifying respirators and complete head and body coverings. The decontamination system consisted of a changing room outside the testing area, and a clean suit-up room. The decontamination system was used each time a person exited the study area and the overall containment area.

Analytical Methods

Air samples were analyzed by the standard phase contrast microscopy (PCM) method using the "A" counting rules.

Although the phase contract microscope enhances the analyst's ability to see fibers over other types of light microscopes, the standard procedure does not involve identification steps which specifically determine how many of the fibers counted are actually asbestos. Because packing material is known to contain other types of fibers, some of the samples were prepared by transmission electron microscopy (TEM) following the AHERA preparation procedure. They were analyzed using the International Standards Organization (ISO) Direct procedure. The TEM analysis method identifies asbestos fibers on the basis of morphology, crystal structure and x-ray elemental analysis. Asbestos fibers longer than 0.5 μm were counted.

Polarized light microscopy (PLM) was used to determine the type of asbestos in the samples of packing material removed from the valve. A friability test was performed on samples of packing material that had been removed from valve.

The friability test to determine whether or not an asbestos-containing material (ACM) potentially will release asbestos is a field test in which an attempt is made to crumble the ACM by hand. If the material can be crumbled by hand, it is considered friable. The U.S. Environmental Protection Agency (EPA) distinguishes friable from non-friable ACM in their regulations on handling asbestos products. Friable ACM is considered more of a potential hazard than non-friable material.

Results

The results of the air monitoring are shown in Table I. During the valve packing removal activity, which lasted approximately one hour, the asbestos fiber level for the person removing the packing was in the range of 0.1 fiber/cc. A personal sample on the person nearby the packing remover was 0.09 f/cc. The area-samples collected in the vicinity of the packing removal activity showed levels of fibers elevated over the background levels. During the repacking of the valve with asbestos-containing packing, the levels of fibers in the vicinity of the worker were below the detectable limit of 0.17 f/cc. The high detectable limit is a result of the short time it took to repack the valve: 7 minutes.

The TEM analysis results are shown in Table II. Chrysotile fibers were identified as the primary type of fiber. Only fibers greater than 5.0 μm are counted using the PCM method. Therefore, two TEM asbestos concentrations are listed. One of all

asbestos fibers greater than 0.5 μm , and one which includes only those fibers over 5 μm in length.

The used packing, removed from the valve, was friable. Polarized light microscopic analysis showed it to be approximately 80% chrysotile (Appendix C). Scanning electron microscopy examination of the removed packing showed free chrysotile asbestos fibers uncoated by any binder.

Conclusions

Asbestos packing, although not considered friable in original, unused condition, can become friable after use in valves and can release asbestos fibers into the air during valve packing removal operations.

There was no evidence of asbestos fiber release causing airborne asbestos levels over 0.2 f/cc during repacking of the valve.

Recommendations

The results of these tests suggest that asbestos packing material, although not considered as a friable ACM when new, should be considered as such during packing removal activities. If possible, the packing should be wetted with water or oil before it is cut and torn with packing tools such as hooks and screw drivers during the procedures for removing old packing.

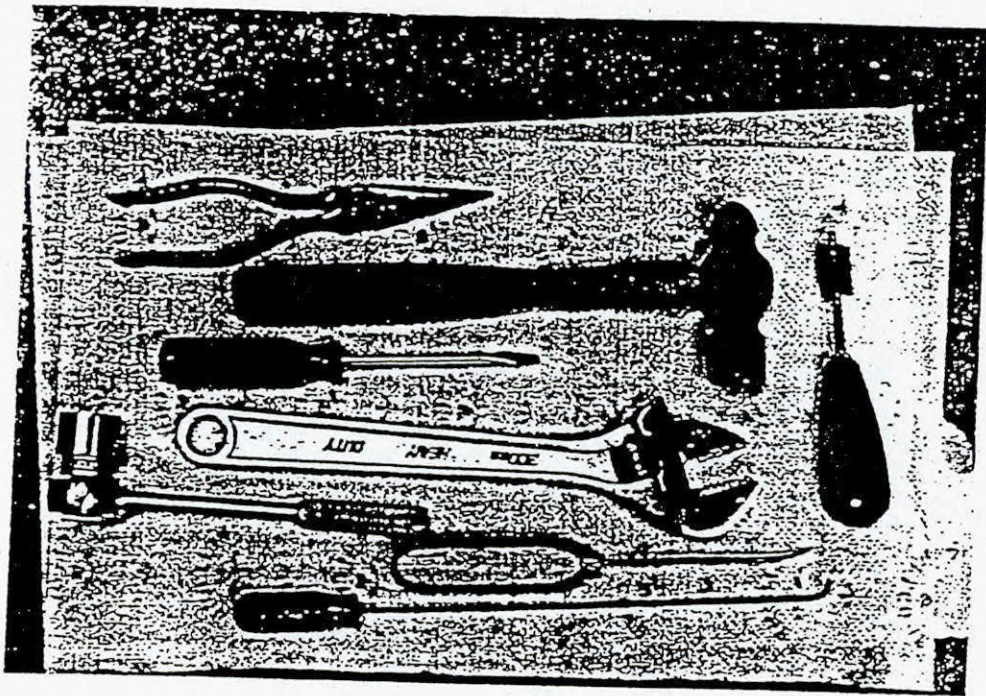


Figure 1. Packing removal tools.

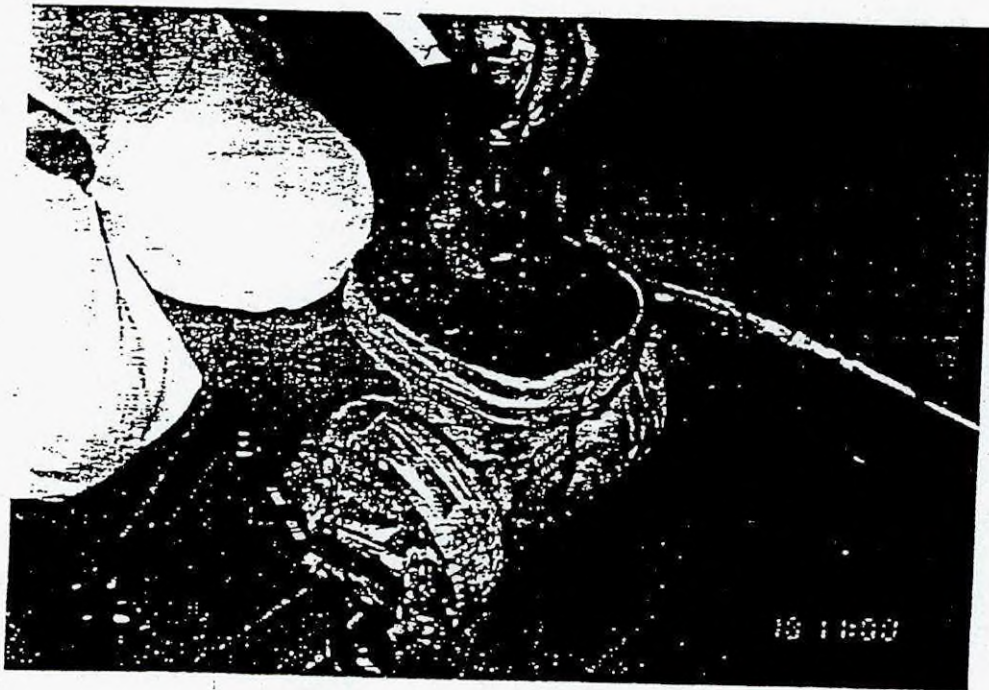


Figure 2. Valve with some packing removed.

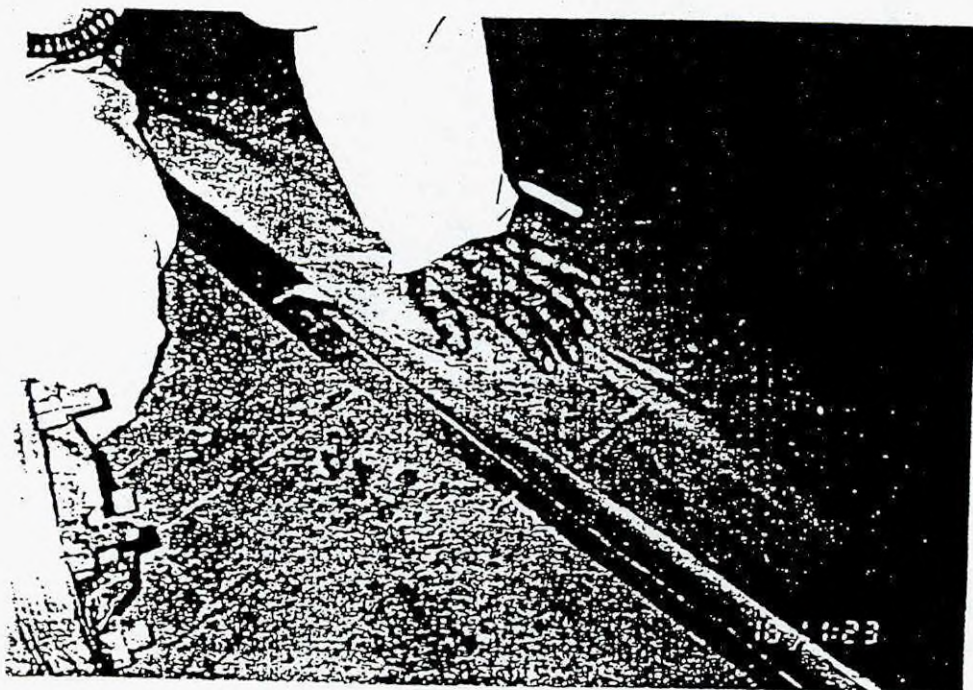


Figure 3. Packing removed from valve.



Figure 4. Removing packing.



Figure 5. Removing packing.



Figure 6. Repacking.



Figure 7. Pushing down gland during repacking.

TABLE I

Phase Contrast Microscopy (PCM) Results of Air
Monitoring Prior to and During Asbestos Packing Removal

Sample Description	Sample Duration (min)	Air Volume (liters)	Concentration (fibers/cc)
Area, Before Packing Removal	110	1100	0.002*
Area, Before Packing Removal	110	1100	0.002*
Area, Before Packing Removal	110	1100	0.002*
Personal, Packing Remover	62	136.4	0.14
Personal, Packing Remover	62	136.4	0.15
Personal, Helper	62	136.4	0.09
Area, During Packing Removal	66	330	0.10

*Limit of Detection (LOD)

TABLE II

Transmission Electron Microscopy (TEM)
Results on Personal Air Monitoring Samples

During Packing Removal

MVA #	Sample Description	Asbestos Concentration (fibers/cc)	
		All > 0.5 μ m	> 5 μ m
D0566	Personal, Packing Remover	1.4	0.3
D0567	Personal, Packing Remover	0.4	<0.04
D0568	Personal, Helper	0.6	0.2

APPENDIX A

Phase Contrast Microscopy (PCM) Analyses Data

Project Name: Valve Experiment
Site: MVA Containment

Project No: 0491

Method: 7400 "A"
Filter Area: 385 mm²
Relc. Area 0.0079 mm²

Sample No.	Date	Sample Location/ Description	Average Flow (L/Min)	Duration (Min)	Volume (L)	Fibers Counted	Fields Counted	Concentration Density f/mm ²	Result f/cc
1	03/18/93	Background, In Northwest Corner of Containment	10	110	1100	2	100	2.5	<0.002
2	03/18/93	Background, In Northeast Corner of Containment	10	110	1100	1.5	100	1.9	<0.002
3	03/18/93	Background, On South Wall, Center	10	110	1100	5	100	6.4	<0.002
4	03/18/93	Personal, Worker, Right Side, During Packing Removal	2.2	62	136.4	39	100	49.7	0.140
5	03/18/93	Personal, Worker, Left Side, During Packing Removal	2.2	62	136.4	41	100	52.2	0.147
6	03/18/93	Personal, On Helper Left Side, During Packing Removal	2.2	62	136.4	25.5	100	32.5	0.092
7	03/18/93	Area, Center of South Wall, During Packing Removal	5	66	330	71.5	100	91.1	0.106

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Project Name: Valve Experiment
Site: MVA Containment

Project No: 0491

Method: 7400 "A"
Filter Area: 385 mm²
Relc. Area 0.0079 mm²

Sample No.	Date	Sample Location/ Description	Average		Volume (L)	Fibers Counted	Fields Counted	Concentration	
			Flow (L/Min)	Duration (Min)				Density f/mm ²	Result f/cc
8	03/18/93	Background, Northwest Corner of Containment	10	36	360	0	100	0.0	<0.008
9	03/18/93	Background, Northeast Corner of Containment	10	36	360	2	100	2.5	<0.008
10	03/18/93	Personal, Worker, Right Side, During Packing	2.2	7	15.4	2.5	100	3.2	<0.17
11	03/18/93	Personal, Worker, Left Side, During Packing	2.2	7	15.4	0	100	0.0	<0.17
12	03/18/93	Area, Center of South Wall During Packing	5	7	35	0	100	0.0	<0.07
13	03/18/93	Field Blank	0	0	0	1.5	100	1.9	ERR
14	03/18/93	Sealed Blank	0	0	0	0	100	0.0	ERR
15	03/19/93	Clearance, Northwest	10	126	1260	3.5	100	4.5	<0.002

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Project Name: Valve Experiment
Site: MVA Containment

Project No: 0491

Method: 7400 "A"
Filter Area: 385 mm²
Retc. Area 0.0079 mm²

Sample No.	Date	Sample Location/ Description	Average		Volume (L)	Fibers Counted	Fields Counted	Concentration	
			Flow (L/Min)	Duration (Min)				Density f/mm ²	Result f/cc
16	03/19/93	Clearance, Northeast	10	126	1260	3	100	3.8	<0.002
17	03/19/93	Clearance, Center South Wall	10	126	1260	7.5	100	9.6	0.003
18	03/19/93	Field Blank	0	0	0	0	100	0.0	NA

APPENDIX B

Transmission Electron Microscopy (TEM) Data Sheets

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0563
CLIENT SAMPLE NO: 1

DATE: 03/23/93

Amount collected: 1100 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 10
Number of asbestos structures counted: 0
Number of fibers longer than 5 µm: 0
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1	D3	NSD*				
	E1	NSD				
	G1	NSD				
	E8	NSD				
	C2	NSD				
2	E9	NSD				
	D6	NSD				
	G2	NSD				
	H4	NSD				
	C7	NSD				

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0564
CLIENT SAMPLE NO: 2

DATE: 03/23/93

Amount collected: 1100 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 10
Number of asbestos structures counted: 0
Number of fibers longer than 5 µm: 0
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1	I8	NSD*				
	G5	NSD				
	D1	NSD				
	H10	NSD				
	J8	NSD				
2	D10	NSD				
	I9	NSD				
	F8	NSD				
	H4	NSD				
	J9	NSD				

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0566
CLIENT SAMPLE NO: 4

DATE: 03/22/93

Amount collected: 136.4 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 10
Number of asbestos structures counted: 42
Number of fibers longer than 5 µm: 10
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1 G7	1	MC+0	11.57	10.19		
		MB	2.78	0.23	CDX	
H3	2	F	2.08	0.05	CD	
	3	MC+0	6.02	3.47		
	4	MC++	22.22	6.94	CD	
	5	B	8.80	2.31	CD	
G2	6	B	2.78	0.69	CD	
	7	MC30	8.33	8.33		
		MF	2.55	0.05	CD	
		MB	1.85	0.93	CD	
		MF	0.69	0.05	CD	
	8	B	2.78	0.93	CD	
	9	CC+0	4.86	2.31	CD	
	10	MD+1	13.89	3.70		
		MB	11.57	0.46	CDX	
	11	F	3.70	0.09	CD	
H6	12	MD+0	24.07	11.57	CD	
	13	MC10	9.72	4.63		
F10		MF	0.93	0.05	CD	
	14	MC+1	27.78	9.26		
		MB	9.26	0.69	CD	
	15	B	11.11	0.74	CD	
	16	F	0.97	0.09	CD	
	17	B	1.85	0.28	CD	

*No Asbestos Structures Detected

MVA PROJECT NO: 0491 DATE: 03/22/93
MVA SAMPLE NO: D0566
CLIENT SAMPLE NO: 4

Grid/ Opening	Structure Number	Structure Type	Length μm	Width μm	Identi- fication	Comments
1 F10	18	F	2.08	0.05	CD	
	19	B	8.80	0.23	CDX	
	20	CC+0	1.85	1.39	CD	
2 H9	21	B	1.39	0.37	CD	
	22	F	0.69	0.05	CD	
	23	F	1.48	0.05	CD	
D9	24	CC+0	3.24	1.16		
		CB	1.39	0.23	CD	
		CB	0.69	0.14	CD	
	25	MD10	1.16	0.46		
		MF	0.93	0.09	CD	
	26	B	3.24	0.93	CD	
	27	MC30	6.94	3.70		
		MB	1.85	0.14	CD	
		MB	0.93	0.46	CD	
		MB	0.69	0.09	CD	
	28	B	2.31	0.14	CD	
	29	B	1.85	0.14	CD	
G10	30	F	0.69	0.09	CD	
	31	B	2.31	0.46	CD	
	32	B	0.93	0.46	CD	
	33	B	1.16	0.37	CD	
	34	B	33.33	2.31	CDX	
	35	B	2.31	0.37	CD	
	36	MC10	11.11	5.56		
		MB	2.08	0.09	CD	
E5	37	B	2.78	0.32	CD	
	38	B	36.11	4.63	CD	
A10	39	B	0.69	0.09	CD	
	40	F	2.08	0.14	CD	
	41	MD10	2.31	0.37		
		MB	2.31	0.09	CD	
	42	MC11	26.85	3.70		
		MB	26.85	1.85	CD	

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0567
CLIENT SAMPLE NO: 5

DATE: 03/22/93

Amount collected: 136.4 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 10
Number of asbestos structures counted: 11
Number of fibers longer than 5 µm: 0
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1	F9	NSD*				
	E8	NSD				
	C3	1	MC30	3.24	3.24	
			MF	0.69	0.05	CD
			MF	0.69	0.05	CD
			MF	0.56	0.05	CD
	B3	2	MC20	2.78	0.93	
			MF	0.46	0.05	CD
			MF	1.16	0.05	CD
	C5	NSD				
2	E7	NSD				
	G3	3	F	1.85	0.09	CD
		4	B	1.39	0.14	CD
		5	MC10	1.62	0.93	
			MB	0.69	0.19	CDX
		6	B	1.85	0.37	CD
	I5	NSD				
	A5	7	CC+0	3.94	2.22	CD
		8	CC+0	2.78	1.62	CD
		9	F	1.62	0.14	CD
I3		10	MC50	12.96	12.50	
			MB	4.40	0.14	CD
			MF	0.83	0.09	CD
			MB	2.78	0.09	CD
			MF	1.39	0.05	CD

*No Asbestos Structures Detected

MVA PROJECT NO: 0491 DATE: 03/22/93
MVA SAMPLE NO: D0567
CLIENT SAMPLE NO: 5

Grid/ Opening	Structure Number	Structure Type	Length μ m	Width μ m	Identi- fication	Comments
2 13		MB	0.56	0.19	CD	
	11	CC+0	1.39	0.93	CD	

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0568
CLIENT SAMPLE NO: 6

DATE: 03/22/93

Amount collected: 136.4 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 10
Number of asbestos structures counted: 19
Number of fibers longer than 5 µm: 6
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1 H4	1	CD30	1.85	1.39		
		CB	1.85	0.23	CD	
		CF	1.16	0.05	CD	
		CF	0.69	0.05	CD	
	2	F	0.97	0.05	CD	
	3	MD22	12.96	6.48		
		MB	7.87	0.56	CD	
		MB	11.11	1.39	CD	
	4	B	3.70	0.28	CD	
	5	B	1.16	0.23	CD	
	6	MC10	1.85	1.39		
		MF	0.93	0.14	CD	
	7	B	2.87	0.46	CDX	
	8	B	2.78	0.37	CD	
B5	NSD*					
G4	9	MC40	5.56	4.63		
		MB	0.69	0.23	CD	
		MB	1.02	0.14	CD	
		MF	1.16	0.05	CD	
	10	CC+0	2.31	2.08	CD	
	11	MC10	2.31	1.62		
		MD	0.69	0.14	CD	
	NSD					
	12	MC10	6.48	4.17		
		MF	0.46	0.02	CD	
2 C1						
E4						
F9						

*No Asbestos Structures Detected

MVA PROJECT NO: 0491 DATE: 03/22/93
MVA SAMPLE NO: D0568
CLIENT SAMPLE NO: 6

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
2 D2	13	B	5.09	0.37	CD	
	14	CC+0	3.70	1.85	CD	
	15	MC70	19.91	13.94		
		MF	1.39	0.05	CD	
		MF	0.93	0.05	CD	
		MC	2.78	3.24	CD	
		MF	1.85	0.05	CD	
		MB	1.02	0.23	CD	
		MB	2.22	0.42	CD	
		MF	1.85	0.05	CD	
	16	B	6.48	0.69	CD	
	17	B	2.78	0.19	CD	
	18	F	0.69	0.05	CD	
	E2 19	MC+2	12.96	12.04		
		MB	7.41	0.69	CDX	
		MB	7.87	0.46	CD	
		MB	2.78	0.19	CD	
		MC	0.69	0.69	CD	
		MC	1.16	0.69	CD	

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0572
CLIENT SAMPLE NO: 10

DATE: 03/22/93

Amount collected: 15.4 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 20
Number of asbestos structures counted: 1
Number of fibers longer than 5 µm: 0
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1	H1	NSD*				
	F3	1	F	0.97	0.05	CD
	I5	NSD				
	H6	NSD				
	D7	NSD				
	H5	NSD				
	D8	NSD				
	G3	NSD				
	C8	NSD				
	J5	NSD				
2	I2	NSD				
	J7	NSD				
	J8	NSD				
	F7	NSD				
	G9	NSD				
	J6	NSD				
	C3	NSD				
	B3	NSD				
	I3	NSD				
	G5	NSD				

*No Asbestos Structures Detected

MVA, Inc.
SAMPLE ANALYSIS INFORMATION

MVA PROJECT NO: 0491
MVA SAMPLE NO: D0573
CLIENT SAMPLE NO: 11

DATE: 03/22/93

Amount collected: 15.4 liters
Amount prepped: Direct liters
Area of collection filter: 385 mm²
Magnification used for fiber counting: 21600
Aspect ratio for fiber definition: 3:1
Mean dimension of grid openings: 0.0085 mm²
Number of grid openings examined: 11
Number of asbestos structures counted: 1
Number of fibers longer than 5 µm: 0
Initials of Analyst: ATC

Grid/ Opening	Structure Number	Structure Type	Length µm	Width µm	Identi- fication	Comments
1 B7	1	MC10 MF	2.78 0.69	1.62 0.05	CD	
D8	NSD*					
D6	NSD					
E8	NSD					
D9	NSD					
C8	NSD					
2 I2	NSD					
F2	NSD					
E3	NSD					
H1	NSD					
G3	NSD					

*No Asbestos Structures Detected

APPENDIX C

Polarized Light Microscopy (PLM) and Scanning Electron Microscopy (SEM) of Packing Material Removed from Valve

MVA, Inc.

PLM Constituent Analysis

Date: 03/20/93

MVA#: 0491

Location: Packing removed from valve during experiment

Sample I.D.#: D0577

Client Sample I.D.#: BLK-2

Examination using the stereomicroscope: D0577 is a brown to white fibrous material with a silver-gray coating having a metallic luster. Strands of metal wire are also present.

<u>CONSTITUENT</u>	<u>%</u>	<u>CONSTITUENT</u>	<u>%</u>	<u>CONSTITUENT</u>
Fibers:		Pigment:		Fillers:
Cotton	*	Binders:		Diatoms
Fiberglass		Kaolinite	---	Iron Chromite
Filament	---	Montmorillonite	---	Iron Oxide
Wool	---	Gypsum	---	Limestone
Mineral Wool	---	Anhydrite	---	Magnetite
Hair	---	Portland Cement	---	Mica
Paper/Wood		Lime (hydrated)	---	Perlite
Chem. Proc.	---	Precipitated		Synthetic Foam
Mech. Proc.	---	Carbonate	---	Pumice
Synthetic Rayon	*	Starch	---	Quartz
Other:		Other:		Talc
Metal Wire	~ 4	Graphite	**	Vermiculite

Asbestos Minerals

Chrysotile	~ 75-85	Anthophyllite	---	Tremolite/
Amosite	---	Crocidolite	---	Actinolite

Comments: *Rayon is delustered and appears to be concentrated adjacent to metal wire. The outer particles of the wraps, away from the metal wire cores, contain degraded fiber fragments which may be highly altered rayon and/or cotton. Rayon and cotton therefore comprise an estimated 5-10% of the sample with rayon=cotton.

**Graphite plus magnetic particles (magnetite and/or metal fragments) comprise ~10% of the sample.

Analyst: Randy Boltin

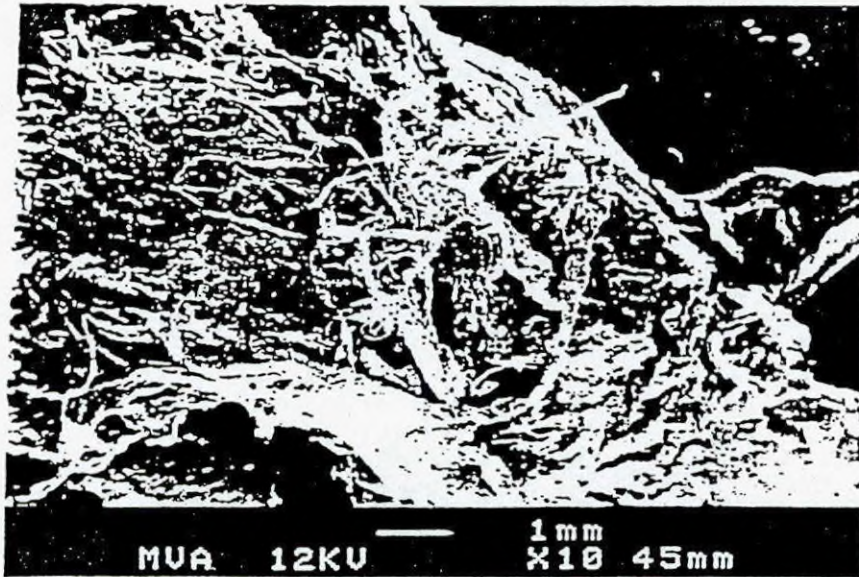


Figure C1. MVA0478-D0577: Packing removed from valve.
Secondary Electron Image (SEI) = 10X.

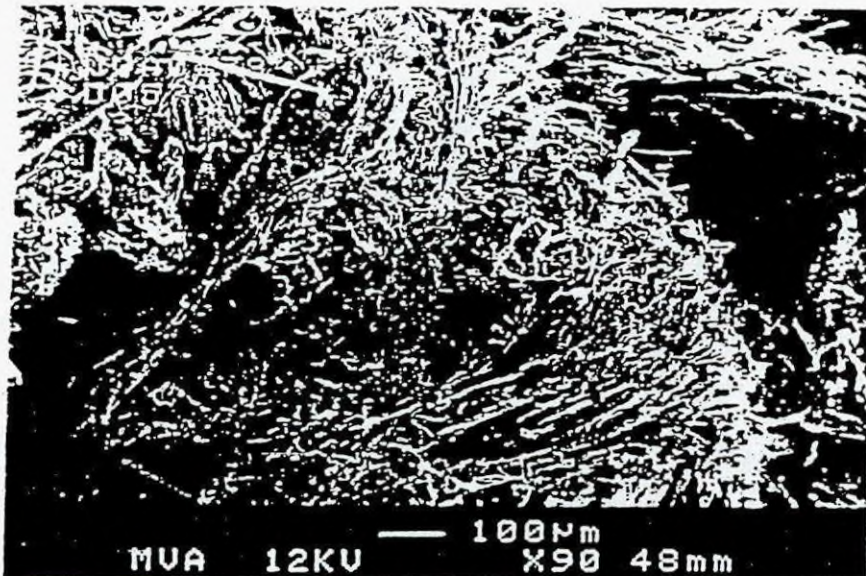


Figure C2. MVA0478-D0577: Packing removed from valve.
SEI = 90X. Closer view of area in Figure C1.

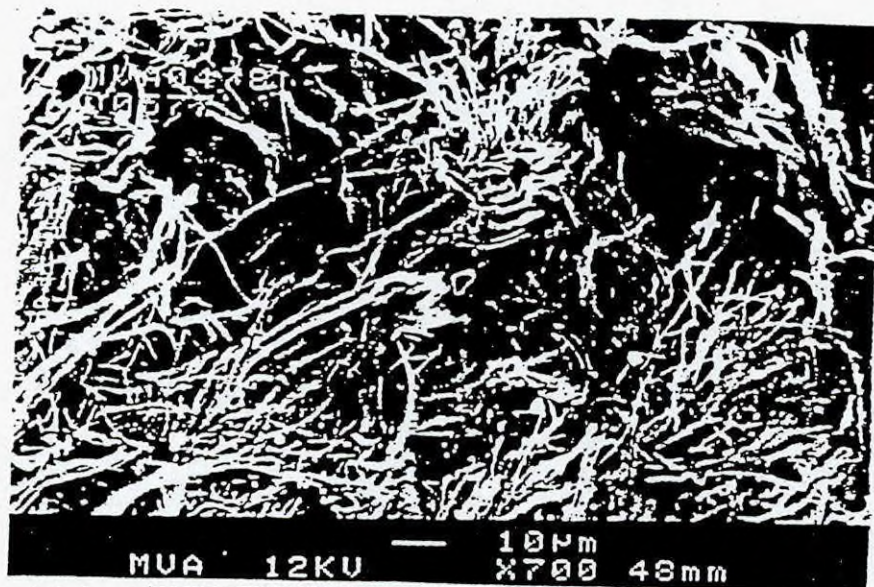


Figure C3. MVA0478-D0577: Packing removed from valve.
SEI = 700X. Closer view of area in C2.