MED-TOX ASSOCIATES INC.

# REPORT ON ASBESTOS

# BULK AND AIR SAMPLING SURVEY

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## SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT HEADQUARTERS

425 SOUTH MAIN STREET
LOS ANGELES, CALIFORNIA

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PREPARED BY:

MED-TOX ASSOCIATES, INC.
TUSTIN, CALIFORNIA

MED-TOX ASSOCIATES, INC.

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# TABLE OF CONTENTS


INTRODUCTION

SCOPE OF WORK

SAMPLING AND ANALYTICAL METHODS

Bulk Sampling
Air Sampling

BULK SAMPLE RESULTS

AIR MONITORING RESULTS

RECOMMENDATIONS

CONCLUSION

TABLES

| | | |
|---|---|---|
| I | - | Bulk Sample Results and Locations |
| II | - | Air Sampling Results and locations (PCM) |
| III | - | Air Sampling and Locations (TEM) |

APPENDICES

| | | |
|---|---|---|
| A | - | Laboratory Reports (Bulk Samples) |
| B | - | Laboratory Reports (PCM) |
| C | - | Laboratory Reports (TEM) |
| D | - | Photographs |
| E | - | Asbestos Management Program |
| F | - | Federal OSHA Asbestos Standard |
| G | - | Investigative Outline |
| H | - | Interim Report |
| I | - | Sample Location Map |

## INTRODUCTION

Med-Tox Associates, Inc. (MED-TOX) conducted a comprehensive asbestos bulk survey and air monitoring on February 23 through 26, 1988 at the Southern California Rapid Transit District (S.C.R.T.D.) headquarters located at 425 South Main Street, Los Angeles, California. The objectives of the survey were to identify accessible Asbestos Containing Materials (ACM), evaluate conditions of all identified ACM, determine the amount of fiber release from the ACM, and make recommendations based on results. The bulk survey focused on all accessible areas were ACM may be present. The work was conducted by industrial hygienists under the supervision of Mr. Al Perez, Certified Industrial Hygienist.

Please note that an Investigation Outline and Interim Report were submitted in accordance with the contract and are included in Appendix G and H, respectively.

## SCOPE OF WORK

The building survey began with a review of available construction drawings and visual inspection of all accessible floor and roof areas. Collection of bulk samples from suspect materials were taken to identify and locate all accessible ACM. Suspect materials sampled included, but were not limited to: floor tile, ceiling tile, pipe insulation, mechanical insulation and sprayed-on fireproofing. Air samples were also taken throughout the facility and analyzed either by Phase Contrast Microscopy (PCM) or Transmission Electron Microscopy (TEM).

## SAMPLING AND ANALYTICAL METHODS

### Bulk Sampling

Collection of bulk samples was performed in accordance with EPA Guidance Documents. Samples were collected by extracting a representative section of the selected material and placing it in a specimen vial and assigning it a unique sampling number. The vials were placed in their original containers and sealed for shipment.

The method of analysis for bulk samples was conducted by polarized light microscopy (PLM) and dispersion staining techniques in accordance with EPA Analytical Method Number 600/M4-82-020, December, 1982. Current California and federal laws regard any materials which have greater than one percent asbestos as an ACM. Materials with less than one (1) percent asbestos are defined as having "trace" amounts.

Air Sampling

Phase Contrast Microscopy (PCM) samples were collected on 25 millimeter, 0.8 micron pore size mixed cellulose ester filter cassettes with 50 millimeter, conductive cowls. Transmission Electron Microscopy (TEM) samples were collected on 25 millimeter, 0.4 micron pore sized polycarbonate filter cassettes with 50 millimeter non-conductive cowls. Sample air was drawn through the cassettes at a rate of 9.3 to 12.0 liters per minute (lpm) using BGI high flow sampling pumps.

Air samples collected were analyzed by either Phase Contrast Microscopy (PCM) or Transmission Electron Microscopy (TEM). PCM samples were analyzed using National Institute of Occupational Safety and Health (NIOSH) Method 7400. NIOSH Method 7400 identifies all fibers collected which exceed five (5) microns in length and have a length-to-width ratio of three-to-one (3:1) or greater. PCM counts all fibers and does not distinguish between asbestos and non-asbestos fibers.

Transmission Electron Microscopy (TEM) samples were analyzed at an accelerating voltage of 80 KV - 100 KV TEM with a fluorescent viewing screen inscribed with graduation for estimating the length and width of fibrous particulates. The EM grid, where the particulates were transferred from the collection filter, is examined under low magnification (250x - 1000x) followed by high-magnification (film magnification of 20,000x, which is equivalent to 16,000x on the fluorescent screen) search and analysis.

A known area (measured grid opening) is scanned, and the asbestos structures (fibers, bundles, clusters and matrices) are counted, sized and identified as to asbestos type (chrysotile, amphibole, ambiguous, or no identity) by morphology and by observing the SAED pattern. Additional grid openings are selected, scanned counted until either the total number of structures counted exceeds 100 per known area or a minimum of 10 grid openings have been scanned, which ever occurs first.

## BULK SAMPLE RESULTS

Please refer to Table I and Appendix A for bulk sample results and laboratory reports, respectively. Selected photographs are included in Appendix D. Sample locations are identified individually on floor plans included in Appendix I.

## SUMMARY

ACM was found primarily as pipe insulation, sprayed-on fireproofing, and nine-by-nine floor tile. No ACM was detected in the ceiling tiles located throughout the facility. Other materials

that were sampled, but did not contain ACM were: twelve-by-twelve inch floor tiles, wall plaster, and sprayed on fire-proofing on the forth floor of Annex C.

Boiler Room - Basement

Several samples were collected of insulation materials on the pipe runs and elbows, on the hot water tank, and the Superior Heat Exchanger. The sample results ranged from 5 to 80 percent asbestos in the form of either chrysotile, amosite, or crocidolite. The ACM in the boiler room was in poor condition, a sample of debris collected off the floor under the main exhaust duct was found to be 80 percent chrysotile.

Fan Room (Basement)

The fan room located in the basement contained ACM on pipe elbows. The majority of pipe runs were insulated with fiberglass. The sample results ranged from no asbestos detected to 40 percent asbestos. Various pipes in the fan room have been abandoned. Some of the abandoned pipes have been sawed off, leaving areas of exposed ACM.

Fan Rooms - Annex 2 - (425 South Main Street)

The fan rooms located in Annex 2 on each floor contains ACM ranging from 5 to 40 percent asbestos. All pipe insulation was in good condition in all Annex 2 fan rooms. The material should be maintained and periodically re-inspected to assure that it remains in good condition.

Annex 2 - (425 South Main Street)

Sprayed on fireproofing on the second, third, fifth and sixth floors of Annex 2 contained ACM ranging from 20 to 30 percent chrysotile. Although the material is friable (easily crumbled by hand pressure) it was in good condition at the time of the survey with very minimal debris on the suspended ceiling. An air handling unit in the basement of the building west of the Print Shop contained insulated pipe elbows with ACM ranging from 5 to 30 percent asbestos. The air handling unit has lines servicing the fan rooms of Annex 2.

Annex 2 contained nine-by-nine inch vinyl asbestos floor tiles (VAT) ranging from no asbestos detected to two (2) percent. All tile was in good condition and does not present an airborne fiber hazard in its present condition.

Annex 1 - (415 South Main Street)

Annex 1 contained sprayed-on fireproofing on the second, third, fourth, and sixth floors with ACM results ranging from 5 to 30 percent asbestos. Other ACM in Annex 1 was pipe insulation in the fan rooms on the fourth floor. The chilled water lines contained asbestos elbows and fiberglass straights. The low pressure steam pipes were entirely ACM. Sample results ranged from 15 to 40 percent asbestos. The west fan room had some debris on the floor that is possibly ACM from deteriorating pipe insulation. The remaining floors of Annex 1 contain air handling equipment in a center core unit. Those units contain ACM on the elbows of pipes with fiberglass straights. The center core units were in good condition. Floor tiles contained asbestos from trace to five (5) percent.

Annex's A, B, C - (411 South Main Street - excluding first and second floors)

The majority of ACM in Annex's A, B, and C was located in the pipe insulation and sprayed-on fireproofing on the fifth floor of Annex's A and B. The fourth floor contained fireproofing that was non-detectable for asbestos. The third floor of Annex's A, B, and C had no sprayed-on fireproofing. Domestic hot water pipes run throughout the building from the basement up through Annex C, outside the restrooms. Other ACM in Annex's A, B, and C were VAT.

Annex's D, E, and F - (124 Fourth Street - excluding floors one through three)

Very little ACM was detected in Annex's D, E, and F. There was one section of sprayed-on fireproofing on the fourth floor that apparently was not removed during remodeling and contained five (5) percent chrysotile asbestos. The material was in good condition, however, there were ceiling tiles missing that exposed the fireproofing. The material was located between column lines seven and eight (7 & 8) to the north corridor.

The seventh floor of the 124 Fourth Street Building is not occupied by SCRTD employees, however, a sample of pipe insulation that was in very poor condition was collected and found to be ten (10) percent chrysotile asbestos. Several pieces of the insulation was on the ground and should be cleaned up by an abatement contractor, and the remaining insulation on the pipe should be removed as it could present a fiber hazard to the RTD facility.

Roof

ACM on the roof was in the form of roofing material, pipe insulation, and transite cooling towers. The sample results ranged from no asbestos detected (method detection limit is one (1) percent) to 50 percent asbestos. The ACM inside the chiller and boiler rooms was in good condition. The ACM outside on the roof that has been exposed to the elements were in poor condition. The cooling tower that is no longer in service contained transite panels that were in poor condition. The silver roofing material throughout the roof contained one (1) percent asbestos.

## AIR MONITORING RESULTS

### Phase Contrast Microscopy (PCM)

A total of 47 PCM samples were collected. PCM counts all fibers that are greater than five (5) microns in length and have a length to width ratio of three to one (3-1) or greater. PCM does not differentiate between asbestos and non-asbestos fibers. All 47 samples were less than 0.01 fibers per cubic centimeter (f/cc) of air sampled. The Environmental Protection Agency (EPA) recommends an occupancy fiber level of 0.01 f/cc following an asbestos abatement activity or any activity that disturbs ACM. Contained within Table II and Appendix B are PCM sample results and laboratory reports respectively.

### Transmission Electron Microscopy (TEM)

A total of seven (7) samples were collected on 0.4 micron polycarbonate filters. The samples were placed in high priority areas such as return air plenums. TEM samples were collected aggressively using an outside air source, eg., fans and leaf flower. TEM differentiates between asbestos and non-asbestos fibers. All TEM sample results were below 0.01 f/cc. Contained within Table III and Appendix C are TEM sample results and laboratory reports respectively. Air sampling locations are identified individually on the floor plans included in Appendix I.

## RECOMMENDATIONS

ACM has been divided into three (3) categories; high priority, medium priority, and low priority ACM. For high priority ACM, MED-TOX recommends removal of the ACM by a state licensed and Cal/OSHA certified asbestos abatement contractor. The high priority areas include the insulation on the main exhaust duct in the basement boiler room and the pipe insulation in the basement

fan room. Another high priority area is the seventh floor of the 124 Fourth Street Building. Although the floor is not occupied by SCRTD, the badly deteriorated pipe insulation may present an airborne fiber hazard to the SCRTD facility and its occupants.

Immediate spill clean-up of debris and insulation repair (or removal) must be completed in the basement boiler and fan rooms to prevent additional contamination. The fallen debris should be cleaned-up by a licensed and certified abatement contractor utilizing a high efficiency particulate air (HEPA) vacuum cleaner under controlled conditions. Under no circumstances should the basement boiler room be cleaned (or swept) by unqualified personal/contractors. All fallen debris in the basement boiler and fan rooms should be considered contaminated until proven otherwise. An Asbestos Management Program must be established to continue normal maintenance activities throughout the SCRTD facility (See Appendix E).

For medium priority ACM, MED-TOX recommends (at a minimum) encapsulation with a contrasting encapsulant and implementation of an Asbestos Management Program. The fireproofing throughout the facility with the exception of the fourth floor of Annex C would be a medium priority area. Encapsulation must also be performed by a state licensed and Cal/OSHA registered asbestos abatement contractor. Please note that encapsulated ACM must be properly maintained, protected and periodically inspected until the building has been selected for demolition, at which time the ACM must <u>first</u> be properly removed and disposed.

Other medium priority areas include damaged main steam header insulation in the basement parking lot and exposed pipe insulation on the roof. These medium priority areas should be repaired (at a minimum) by a licensed contractor qualified to work with or near asbestos.

The low priority areas are the pipe insulation in the fan rooms of Annex 2 and the floor tile throughout the facility. These are designated as low priority because of their good to excellent condition, low accessibility and low potential for disturbance. For low priority areas MED-TOX recommends (at a minimum) implementation of an Asbestos Management Program.

A Contractor Assistance Program must also be established by SCRTD for any maintenance work that requires working in contact with or in close proximity to exposed ACM. The program would provide asbestos abatement services by a state licensed and certified abatement contractor concurrent with maintenance and/or general contractor services. In addition, environmental air monitoring

should be conducted during all abatement and renovation activities. Maintenance and contractor employees would still be required to be trained and wear protective clothing and respiratory equipment when working in close proximity to exposed ACM.

Observations made during this survey indicate that either maintenance and/or contract employees have disturbed asbestos containing insulation materials during maintenance activities. Furthermore, significant deterioration and inadequately repaired insulation have resulted with exposed or spilled ACM. Immediate measures must be implemented to ensure that future disturbance of ACM (which may occur through maintenance or contract activities) is performed only by properly trained and physically qualified employees wearing appropriate respiratory and other protective equipment. An outline of these measures is included in the Operations and Maintenance Section of an Asbestos Management Program. In any event, asbestos-related maintenance activities must comply with the Federal OSHA Asbestos Standard for General Industry (29 CFR 1910.1001) which is included in Appendix F. This standard outlines requirements governing training, medical surveillance, respiratory protection, air monitoring and record-keeping.

## CONCLUSION

The mere presence of asbestos containing material does not constitute a health hazard. However, the ACM must be controlled or removed to prevent exposures to hazardous levels of airborne asbestos. Such exposures may result from disturbances to the ACM through vibration, renovation activities, water damage or incidental contact. If the ACM is to remain, then a comprehensive Asbestos Management Program, which would include an Operations and Maintenance program, must be implemented. Please refer to Appendix E for an outline of an Asbestos Management Program.

Air sampling results were all below the 0.01 f/cc criteria established by the Environmental Protection Agency (EPA) for occupancy following asbestos abatement activities.

Report
Prepared By:

Jennifer Beeby
Project Coordinator

Report
Reviewed and Approved By:

Al Perez, MPH, CIH, CSP
Director,
Industrial Hygiene Services

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# TABLE I

## BULK SAMPLE RESULTS/LOCATIONS

MED-TOX ASSOCIATES INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988

| SAMPLE NUMBER | DESCRIPTION/LOCATION | PERCENT ASBESTOS | | |
|---|---|---|---|---|
| | | CHRYSOTILE | AMOSITE | CROCIDOLITE |
| JLB0223-1 | BLACK 9 X 9 FLOOR TILE BASEMENT RESTROOM | ND | ND | ND* |
| JLB0223-2 | TAN 9 X 9 FLOOR TILE BASEMENT RESTROOM | 5 | ND | ND |
| JLB0223-3 | 4 INCH RETURN LINE - BASEMENT RECEIVING AREA | 20 | 40 | ND |
| JLB0223-4 | 4 INCH RETURN ELBOW - BASEMENT RECEIVING AREA | 40 | 40 | ND |
| JLB0223-5 | 14 INCH ELBOW - BASEMENT RECEIVING AREA | 10 | 40 | ND |
| JLB0223-6 | 2 X 2 FEET PERFERATED CEILING TILE - BASEMENT OUTSIDE OF STATIONARY ROOM | ND | ND | ND |
| JLB0223-7 | 6 INCH ELBOW ABOVE RISER - BASEMENT BOILER ROOM | ND | 10 | 25 |
| JLB0223-8 | 6 INCH PIPE FROM RISER - BASEMENT BOILER ROOM | ND | 20 | 5 |
| JLB0223-9 | ELBOW BELOW RISER OFF WATER TANK NUMBER 2 - BASEMENT BOILER ROOM | ND | 15 | 15 |
| JLB0223-10 | SILVER AIR CELL OFF 10 INCH RISER FROM BLUE WATER HEATER - BASEMENT BOILER ROOM | 70 | ND | ND |
| JLB0223-11 | INSULATION COVER ON SUPERIOR HEAT EXCHANGE NUMBER 13 - BASEMENT BOILER ROOM | 5 | 30 | 15 |
| JLB0223-12 | INSULATION COVER ON SUPERIOR HEAT EXCHANGE NUMBER 14 - BASEMENT BOILER ROOM | 70 | 10 | 5 |
| JLB0223-13 | INSULATION OFF MAIN EXHAUST DUCT - BASEMENT BOILER ROOM | 10 | 25 | 20 |

R293/13
3105

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TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS | | |
|---|---|---|---|---|
| | | CHRYSOTILE | AMOSITE | CROCIDOLITE |
| JLB0223-14 | CLOTH COVERING OFF MAIN EXHAUST DUCT - BASEMENT BOILER ROOM | ND | ND | ND |
| JLB0223-15 | EXHAUST RISER FROM HEAT EXCHANGE NUMBER 14 - BASEMENT BOILER ROOM | 70 | 10 | 5 |
| JLB0223-16 | RISER OFF STEAM HEATER MIDDLE OF NORTH WALL - BASEMENT BOILER ROOM | ND | 30 | 20 |
| JLB0223-17 | INSULATION OFF HOT WATER TANK | 80 | ND | ND |
| JLB0223-18 | 8 INCH RISER OFF HOT WATER TANK - BASEMENT BOILER ROOM | 15 | 30 | ND |
| JLB0223-19 | DEBRIS ON FLOOR UNDER MAIN EXCHANGE DUCT - BASEMENT BOILER ROOM | 80 | ND | ND |
| JLB0223-20 | ELBOW FROM STEAM PIPE OFF MAIN HEADER - BASEMENT ENGINEERS OFFICE | 15 | 20 | 35 |
| JLB0223-21 | STAIR COVERING ON STAIRWELL - BASEMENT OUTSIDE OF VAULT | ND | ND | ND |
| JLB0223-22 | PLASTER COVERING BRICKS - BASEMENT OF BUILDING 415 | ND | ND | ND |
| JLB0223-23 | CEMENT COVERING BRICKS - BASEMENT OF BUILDING 415 | ND | ND | ND |
| JLB0223-24 | 6 INCH PIPE LINE NUMBER 3 OFF PUMP - BASEMENT FAN ROOM | ND | ND | ND |
| JLB0223-25 | 6 INCH ELBOW LINE NUMBER 3 OFF PUMP - BASEMENT FAN ROOM | 20 | 40 | ND |
| JLB0223-26 | DEBRIS OFF AIR HANDLER - BASEMENT FAN ROOM | ND | ND | ND |

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TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS | | |
|---|---|---|---|---|
| | | CHRYSOTILE | AMOSITE | CROCIDOLITE |
| JLB0223-27 | 6 INCH ELBOW OFF HEAT COIL - BASEMENT FAN ROOM | 20 | ND | ND |
| JLB0223-28 | 6 INCH ELBOW FROM HEAT COIL - BASEMENT FAN ROOM | 5 | ND | ND |
| JLB0223-29 | 3 INCH ELBOW OFF NUMBER 2 HEAT COIL - BASEMENT FAN ROOM | 10 | ND | ND |
| JLB0223-30 | 4 INCH PIPE CUT AND ABANDONED ON WEST WALL - BASEMENT FAN ROOM | 35 | ND | ND |
| JLB0223-31 | GREEN 9 X 9 FLOOR TILE - BASEMENT BELT ROOM | ND | ND | ND |
| JLB0223-32 | COVERING ON STAIR'S - BASEMENT BETWEEN FAN AND BELT ROOMS | 5 | ND | ND |
| JLB0223-33 | TAN 9 X 9 FLOOR TILE - BASEMENT STATIONARY ROOM | 2 | ND | ND |
| JLB0223-34 | PLASTER LATH - BASEMENT STATIONARY ROOM | ND | ND | ND |
| JLB0223-35 | WHITE 12 X 12 CEILING TILES - BASEMENT STATIONARY ROOM | ND | ND | ND |
| JLB0223-36 | GREEN 9 X 9 FLOOR TILE - BASEMENT ELEVATOR LOBBY OF 411 BUILDING | 2 | ND | ND |
| JLB0223-37 | GREY 9 X 9 FLOOR TILE - BASEMENT ELEVATOR LOBBY OF 411 BUILDING | TRACE | ND | ND |
| JLB0223-38 | 6 INCH ELBOW NEXT TO TEMPERATURE GAUGE - BASEMENT AIR HANDLING UNIT WEST OF PRINT SHOP | 5 | 30 | ND |
| JLB0223-39 | 6 INCH ELBOW - BASEMENT AIR HANDLING UNIT WEST OF PRINT SHOP | 15 | 15 | ND |

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TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS | | |
|---|---|---|---|---|
| | | CHRYSOTILE | AMOSITE | CROCIDOLITE |
| JLB0223-40 | 2 INCH DOMESTIC HOT WATER SUPPLY LINE - BASEMENT OUTSIDE FREIGHT ELEVATOR | 10 | ND | ND |
| JLB0223-41 | 2 INCH DOMESTIC HOT WATER RETURN LINE - BASEMENT OUTSIDE FREIGHT ELEVATOR | 5 | ND | ND |
| JLB0223-42 | GREY LINOLEUM - BASEMENT PRINT SHOP | ND | ND | ND |
| JLB0223-43 | 2 X 4 CEILING TILE - BASEMENT PRINT SHOP BREAK ROOM | ND | ND | ND |
| JLB0223-44 | 2 X 4 CEILING TILE - BASEMENT PRINT SHOP | ND | ND | ND |
| JLB0223-45 | 2 X 4 CEILING TILE WITH METAL BACK - BASEMENT PRINT SHOP | ND | ND | ND |
| JLB0223-46 | MAINSTEAM HEADER - PARKING LOT IN 415 BUILDING | 5 | 40 | ND |
| JLB0223-47 | DRY STAND PIPE - 1ST FLOOR STAIR-WELL - 425 BUILDING | 10 | 35 | ND |
| JLB0223-48 | 2 X 4 CEILING TILE - 1ST FLOOR; STOPS AND ZONES DEPARTMENT - 411 BUILDING | ND | ND | ND |
| JLB0223-49 | 12 X 12 FLOOR TILE - 1ST FLOOR - 411 BUILDING | ND | ND | ND |
| JLB0223-50 | 6 INCH ELBOW FROM MAIN STEAM HEADER MEZZANINE PARKING LOT - 415 BUILDING | 20 | 10 | ND |
| JLB0223-51 | 6 INCH PIPE MAIN STEAM HEADER - MEZZANINE PARKING - 415 BUILDING | 10 | 30 | ND |
| JLB0223-52 | CEILING TILE - 2ND FLOOR - 425 BUILDING | ND | ND | ND |

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TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS | | |
|---|---|---|---|---|
| | | CHRYSOTILE | AMOSITE | CROCIDOLITE |
| JLB0223-53 | 4 INCH PIPE FROM STEAMLINE - MEZZANINE UP TO ROOF - 425 BUILDING | 15 | 40 | ND |
| JLB0223-54 | 9 X 9 FLOOR TILE UNDER CARPET - 3RD FLOOR - 425 BUILDING | TRACE | ND | ND |
| JLB0223-55 | PLASTER AND LATH - FOOD STORAGE AREA - 3RD FLOOR - 411 BUILDING | ND | ND | ND |

MED-TOX ASSOCIATES INC

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | AMOSITE |
|---|---|---|---|
| JLB0224-1 | 6 INCH PIPE FROM LOW-PRESSURE STEAMLINE - WEST FAN ROOM - 4TH FLOOR - 415 BUILDING | ND | 15 |
| JLB0224-2 | SPRAYED-ON FIREPROOFING - WEST FAN ROOM - 4TH FLOOR - 415 BUILDING | 10 | ND |
| JLB0224-3 | 12 X 12 FLOOR TILE UNDER CARPET - 4TH FLOOR - 415 BUILDING | ND | ND |
| JLB0224-4 | 12 X 12 CEILING TILE - 4TH FLOOR HALLWAY - 415 BUILDING | ND | ND |
| JLB0224-5 | SPRAYED-ON FIREPROOFING - WEST CORRIDOR I-BEAM - 415 BUILDING | 5 | ND |
| JLB0224-6 | SPRAYED-ON FIREPROOFING - SOUTH CORRIDOR I-BEAM - 415 BUILDING | 5 | ND |
| JLB0224-7 | SPRAYED-ON FIREPROOFING-OVERSPRAY ROLM SWITCH ROOM - 4TH FLOOR - 415 BUILDING | 5 | ND |
| JLB0224-8 | SPRAYED-ON FIREPROOFING I-BEAM ROLM SWITCH ROOM - 4TH FLOOR - 415 BUILDING | 5 | ND |
| JLB0224-9 | DEBRIS ON ROLM SWITCH ROOM FLOOR - 4TH FLOOR - 415 BUILDING | 5 | ND |
| JLB0224-10 | TAN 12 X 12 FLOOR TILE ROLM SWITCH ROOM - 4TH FLOOR - 415 BUILDING | ND | ND |
| JLB0224-11 | BLACK 12 X 12 FLOOR TILE ENTRANCE TO 411 BUILDING OUTSIDE RESTROOMS | ND | ND |
| JLB0224-12 | RED FLOORING RESTROOMS - 4TH FLOOR 411 BUILDING | ND | ND |
| JLB0224-13 | SPRAYED ON FIREPROOFING I-BEAM OUTSIDE RESTROOMS - 4TH FLOOR - 411 BUILDING | ND | ND |

R293/13
3105

MED-TOX ASSOCIATES INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | AMOSITE |
|---|---|---|---|
| JLB0224-14 | SPRAYED-ON FIREPROOFING WEST HALLWAY - 4TH FLOOR - 411 BUILDING | ND | ND |
| JLB0224-15 | SPRAYED-ON FIREPROOFING - 4TH FLOOR - 124 BUILDING | 5 | ND |
| JLB0224-16 | SPRAYED-ON FIREPROOFING - 4TH FLOOR - 124 BUILDING | 5 | ND |
| JLB0224-17 | SPRAYED-ON FIREPROOFING - 4TH FLOOR - 124 BUILDING | 5 | ND |
| JLB0224-18 | 6 INCH PIPE LOW PRESSURE STREAMLINE - 4TH FLOOR EAST FAN ROOM - 415 BUILDING | 15 | 40 |
| JLB0224-19 | 6 INCH ELBOW CHILLED WATER - 4TH FLOOR EAST FAN ROOM - 415 BUILDING | 25 | 35 |
| JLB0224-20 | 6 INCH PIPE - 4TH FLOOR COMPUTER FAN ROOM - 425 BUILDING | 5 | 35 |
| JLB0224-21 | 2 X 4 CEILING TILE WITH METAL BACK - 4TH FLOOR - 425 BUILDING | ND | ND |
| JLB0224-22 | PLASTER IN WALL - COMPUTER ROOM - 4TH FLOOR - 425 BUILDING; | ND | ND |
| JLB0224-23 | 8 INCH ELBOW AIR HANDLER - CENTER CORE FAN ROOM - 5TH FLOOR - 415 BUILDING | 15 | 35 |
| JLB0224-24 | TAN 9 X 9 FLOOR TILE - 5TH FLOOR - 415 BUILDING | 2 | ND |
| JLB0224-25 | DEBRIS ON FLOOR - CENTER CORE FAN ROOM - 5TH FLOOR - 415 BUILDING | ND | ND |
| JLB0224-26 | 9 X 9 FLOOR TILE SOUTHEAST STAIRWELL - 5TH FLOOR - 425 BUILDING | TRACE | ND |

MED-TOX ASSOCIATES INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | AMOSITE |
|---|---|---|---|
| JLB0224-27 | 9 X 9 FLOOR TILE - 5TH FLOOR ANNEX A | ND | ND |
| JLB0224-28 | SPRAYED-ON FIREPROOFING I-BEAM EAST CORNER - 5TH FLOOR - ANNEX A | 5 | ND |
| JLB0224-29 | SPRAYED-ON FIREPROOFING - EAST ROOM - 5TH FLOOR - ANNEX A | ND | ND |
| JLB0224-30 | SPRAYED -ON FIREPROOFING - WEST ROOM - 5TH FLOOR - ANNEX A | ND | ND |
| JLB0224-31 | PLASTER - 6TH FLOOR - ANNEX C | TRACE | ND |
| JLB0224-32 | 8 INCH PIPE - 7TH FLOOR - 410 SPRING STREET BUILDING | 10 | ND |
| JLB0224-33 | SILVER ROOFING MATERIAL | 1 | ND |
| JLB0224-34 | 6 INCH PIPE FROM FAN UNIT - ROOF | 5 | ND |
| JLB0224-35 | 6 INCH PIPE CHILLED WATERLINE - ROOF | 15 | ND |
| JLB0224-36 | COOLING TOWER PANEL SLATS - ROOF | 40 | ND |
| JLB0224-37 | CORRIGATED PANELS ON EAST AND WEST SIDES OF COOLING TOWER - ROOF | 50 | ND |
| JLB0224-38 | CLOTH WRAP OFF CHILLED WATER PUMP NUMBER 82 - ROOF - 425 BUILDING | ND | ND |
| JLB0224-39 | CHILLED WATER HEADER OFF PUMPS NUMBER 81 AND 82 - ROOF - 425 BUILDING | 25 | 40 |
| JLB0224-40 | INSULATION ON YORK LIQUID CHILLING SYSTEM - ROOF | 30 | 30 |
| JLB0224-41 | 6 INCH ELBOW OFF YORK LIQUID CHILLING SYSTEM - ROOF | ND | ND |

MED-TOX ASSOCIATES, INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | PERCENT ASBESTOS AMOSITE |
|---|---|---|---|
| JLB0224-42 | INSULATION ON YORK REFRIGERATION AIR CONDITIONER - ROOF | 20 | 20 |
| JLB0224-43 | ELBOW WITH BLACK WRAP ON YORK REFRIGERATION - ROOF | 50 | 30 |
| JLB0224-44 | INSULATION OF EXPANSION TANK - ROOF BOILER ROOM | 45 | 30 |
| JLB0224-45 | 8 INCH ELBOW OFF RISER FROM BOILER NUMBER 12 - ROOF BOILER ROOM | 25 | 25 |
| JLB0224-46 | INSULATION ON BOILER NUMBER 11 - ROOF BOILER ROOM | 30 | 45 |
| JLB0224-47 | INSULATION INSIDE PANEL - ROOF ELEVATOR LOBBY | ND | ND |
| JLB0224-48 | INSULATION ON CHILLED WATER VALVE - ROOF ABSORBER ROOM | 50 | 25 |
| JLB0224-49 | INSULATION ON ABSORBER EVAPORATOR HEAD - ROOF ABSORBER ROOM | ND | ND |
| JLB0224-50 | SPRAYED-ON FIREPROOFING - 5TH FLOOR 425 BUILDING | 20 | ND |
| JLB0224-51 | SPRAYED-ON FIREPROOFING - 5TH FLOOR 425 BUILDING | 20 | ND |
| JLB0224-52 | SPRAYED-ON FIREPROOFING - 5TH FLOOR 425 BUILDING | 25 | ND |
| JLB0224-53 | SPRAYED-ON FIREPROOFING - HALLWAY OUTSIDE EMPLOYEE ACTIVITIES - 2ND FLOOR - 425 BUILDING | 25 | ND |
| JLB0224-54 | SPRAYED -ON FIREPROOFING - PUBLIC ELEVATOR LOBBY - 2ND FLOOR - 425 BUILDING | 30 | ND |

MED-TOX ASSOCIATES INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | AMOSITE |
|---|---|---|---|
| JLB0224-55 | SPRAYED-ON FIREPROOFING - EMPLOYMENT OFFICE - 2ND FLOOR - 425 BUILDING | 30 | ND |
| JLB0224-56 | SPRAYED-ON FIREPROOFING - RESTROOM HALLWAY - 3RD FLOOR - 425 BUILDING | 25 | ND |
| JLB0224-57 | SPRAYED-ON FIREPROOFING - SCHEDULEING - 3RD FLOOR - 425 BUILDING | 30 | ND |
| JLB0224-58 | SPRAYED-ON FIREPROOFING - PUBLIC ELEVATOR LOBBY - 3RD FLOOR - 425 BUILDING | 30 | ND |
| JLB0224-59 | SPRAYED-ON FIREPROOFING - 6TH FLOOR - 425 BUILDING | 30 | ND |
| JLB0224-60 | SPRAYED-ON FIREPROOFING - HALLWAY OUTSIDE RESTROOMS - 6TH FLOOR - 425 BUILDING | 25 | ND |
| JLB0224-61 | SPRAYED-ON FIREPROOFING - PUBLIC ELEVATOR LOBBY - 6TH FLOOR - 425 BUILDING | 25 | ND |
| JLB0224-62 | SPRAYED-ON FIREPROOFING - INFORMATION ROOM - 2ND FLOOR - 415 BUILDING | 30 | ND |
| JLB0224-63 | SPRAYED-ON FIREPROOFING - 2ND FLOOR 415 BUILDING | 30 | ND |
| JLB0224-64 | SPRAYED-ON FIREPROOFING - 2ND FLOOR 415 BUILDING | 25 | ND |
| JLB0225-66 | SPRAYED-ON FIREPROOFING - 3RD FLOOR 124 BUILDING | 20 | ND |
| JLB0225-67 | SPRAYED-ON FIREPROOFING - 3RD FLOOR 124 BUILDING | 15 | ND |

MED-TOX ASSOCIATES, INC.

TABLE I
POLARIZED LIGHT MICROSCOPY
S.C.R.T.D.
FEBRUARY 23-25, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | PERCENT ASBESTOS CHRYSOTILE | AMOSITE |
|---|---|---|---|
| JLB0225-68 | SPRAYED-ON FIREPROOFING - 3RD FLOOR - 415 BUILDING | 25 | ND |
| JLB0225-69 | SPRAYED-ON FIREPROOFING GENERAL ACCOUNTING - 3RD FLOOR - 415 BUILDING | 15 | ND |
| JLB0225-70 | SPRAYED-ON FIREPROOFING - 6TH FLOOR - 415 BUILDING | 20 | ND |
| JLB0225-71 | SPRAYED-ON FIREPROOFING - 6TH FLOOR - 415 BUILDING | 15 | ND |
| JLB0225-72 | SPRAYED-ON FIREPROOFING - 6TH FLOOR - 415 BUILDING | 20 | ND |

ND = MEANS NO ASBESTOS DETECTED; RELIABLE METHOD DETECTION LIMIT IS ONE PERCENT (1%).

"TRACE" = MEANS ASBESTOS IDENTIFIED IN SAMPLE: CONCENTRATION LESS THAN RELIABLE DETECTION LIMIT.

* = TILE, VINYL, FOAM, PLASTIC AND FINE POWDER SAMPLES MAY CONTAIN ASBESTOS FIBERS OF SUCH SMALL DIAMETER THAT THOSE FIBERS CANNOT BE DETECTED BY PLM. FOR SUCH SAMPLES MORE SENSITIVE ANALYTICAL METHODS, e.g., XRD, TEM, SEM, ARE RECOMMENDED IF GREATER CERTAINTY ABOUT ASBESTOS CONTENT IS REQUIRED.

MED-TOX ASSOCIATES INC.

# TABLE II

## PHASE CONTRAST MICROSCOPY RESULTS/LOCATIONS

MED-TOX ASSOCIATES INC.

TABLE II
AIRBORNE FIBER DATA
PHASE CONTRAST MICROSCOPY
S.C.R.T.D.
FEBRUARY 24-26, 1988

| SAMPLE NUMBER | LOCATION/DESCRIPTION | AIRBORNE CONCENTRATION (F/CC*) |
|---|---|---|
| DR0224-A1 | 3RD FLOOR - ACCOUNTING OFFICE - 415 BUILDING | <0.002 |
| DR0224-A2 | 3RD FLOOR - PAYROLL OFFICE - 425 BUILDING | <0.002 |
| DR0224-A3 | 4TH FLOOR - SIGN SHOP - 415 BUILDING | 0.005 |
| DR0224-A4 | 4TH FLOOR - JANITORS CLOSET - 425 BUILDING | 0.002 |
| DR0224-A5 | 5TH FLOOR - LIBRARY - 415 BUILDING | <0.002 |
| DR0224-A6 | 5TH FLOOR - PLANNING OFFICE - 425 BUILDING | <0.002 |
| DR0224-A7 | 6TH FLOOR - GENERAL OPERATIONS - 425 BUILDING | <0.002 |
| DR0225-A8 | 6TH FLOOR - ANNEX A | <0.002 |
| DR0225-A9 | 6TH FLOOR - ANNEX B | <0.002 |
| DR0225-A10 | 6TH FLOOR - ANNEX C | <0.002 |
| DR0225-A11 | 5TH FLOOR - ANNEX A | <0.002 |
| DR0225-A12 | 5TH FLOOR - ANNEX B | <0.001 |
| DR0225-A13 | 5TH FLOOR - ANNEX C | <0.002 |
| DR0225-A14 | 5TH FLOOR - ANNEX E - 124 BUILDING | 0.008 |
| DR0225-A15 | 3RD FLOOR - ANNEX A - 411 BUILDING | <0.0009 |
| DR0225-A16 | 4TH FLOOR - ANNEX A | <0.001 |
| DR0225-A17 | 4TH FLOOR - ANNEX B | <0.001 |
| DR0225-A18 | 4TH FLOOR - ANNEX C | <0.001 |

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MED-TOX ASSOCIATES INC.

TABLE II
AIRBORNE FIBER DATA
PHASE CONTRAST MICROSCOPY
S.C.R.T.D.
FEBRUARY 24-26, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | AIRBORNE CONCENTRATION (F/CC*) |
|---|---|---|
| DR0225-A19 | 4TH FLOOR - ANNEX'S E AND F | <0.001 |
| DR0225-A20 | 6TH FLOOR - ANNEX D - 124 BUILDING | 0.0009 |
| DR0225-28 | 6TH FLOOR TRANSPORTATION - 415 BUILDING | <0.001 |
| DR0225-29 | 4TH FLOOR - DISPATCH OFFICE - 415 BUILDING | <0.002 |
| DR0225-30 | 4TH FLOOR - COMPUTER ROOM - 425 BUILDING | <0.002 |
| DR0225-31 | 3RD FLOOR - ACCOUNTING OFFICE - 415 BUILDING | <0.002 |
| DR0225-32 | 3RD FLOOR - CAFETERIA - 415 BUILDING | 0.003 |
| DR0225-33 | 3RD FLOOR - SCHEDULING OFFICE - 425 BUILDING | <0.002 |
| DR0225-34 | 2ND FLOOR - TELEPHONE INFORMATION - 415 BUILDING | <0.003 |
| DR0225-35 | 2ND FLOOR - EMPLOYMENT OFFICE - 425 BUILDING | <0.003 |
| DR0225-36 | 2ND FLOOR - PERSONNEL DEPARTMENT - 425 BUILDING | <0.003 |
| DR0225-37 | 5TH FLOOR - PLANNING OFFICE - 425 BUILDING | <0.004 |
| DR0225-38 | 5TH FLOOR - PLANNING OFFICE - 425 BUILDING | <0.004 |
| DR0225-39 | 5TH FLOOR - GENERAL SERVICES - 415 BUILDING | <0.004 |

MED-TOX ASSOCIATES, INC.

TABLE II
AIRBORNE FIBER DATA
PHASE CONTRAST MICROSCOPY
S.C.R.T.D.
FEBRUARY 24-26, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | AIRBORNE CONCENTRATION (F/CC*) |
|---|---|---|
| DR0225-40 | 6TH FLOOR - GOVERNMENT AFFAIRS - 425 BUILDING | <0.004 |
| DR0226-41 | 6TH FLOOR - ELEVATOR LOBBY - 425 BUILDING | 0.002 |
| DR0226-42 | 6TH FLOOR - TRANSPORTATION - 415 BUILDING | <0.002 |
| DR0226-43 | 6TH FLOOR - ELEVATOR LOBBY - 411 BUILDING | <0.002 |
| DR0226-44 | 6TH FLOOR - ELEVATOR LOBBY - 124 BUILDING | 0.006 |
| DR0226-45 | 5TH FLOOR - ANNEX F - 124 BUILDING | 0.005 |
| DR0226-46 | 5TH FLOOR - ELEVATOR LOBBY - 411 BUILDING | <0.002 |
| DR0226-47 | 5TH FLOOR - ELEVATOR LOBBY - 425 BUILDING | <0.003 |
| DR0226-48 | 4TH FLOOR - ELEVATOR LOBBY - 124 BUILDING | 0.003 |
| DR0226-49 | 4TH FLOOR - ELEVATOR LOBBY - 411 BUILDING | 0.002 |
| DR0226-50 | 4TH FLOOR - ELEVATOR LOBBY - 425 BUILDING | 0.005 |
| DR0226-51 | 4TH FLOOR - DISPATCH OFFICE - 415 BUILDING | <0.003 |

MED-TOX ASSOCIATES INC.

TABLE II
AIRBORNE FIBER DATA
PHASE CONTRAST MICROSCOPY
S.C.R.T.D.
FEBRUARY 24-26, 1988
(continued)

| SAMPLE NUMBER | LOCATION/DESCRIPTION | AIRBORNE CONCENTRATION (F/CC*) |
|---|---|---|
| DR0226-52 | 3RD FLOOR - ELEVATOR LOBBY - 425 BUILDING | 0.004 |
| DR0226-53 | 3RD FLOOR - ELEVATOR LOBBY - 411 BUILDING | <0.004 |
| DR0226-54 | 2ND FLOOR - ELEVATOR LOBBY - 425 BUILDING | <0.004 |

F/CC = FIBERS PER CUBIC CENTIMETER OF AIR SAMPLED.

MED-TOX ASSOCIATES INC

# TABLE III

## TRANSMISSION ELECTRON MICROSCOPY RESULTS/LOCATIONS

MED-TOX ASSOCIATES, INC.

TABLE III
AIRBORNE ASBESTOS DATA
TRANSMISSION ELECTRON MICROSCOPY
S.C.R.T.D.
FEBRUARY 24-26, 1988

| SAMPLE NUMBER | LOCATION/DESCRIPTION | AIRBORNE ASBESTOS CONCENTRATION (STRUCTURES/CuCm) |
|---|---|---|
| DR0225-A21 | 6TH FLOOR - ANNEX E - 124 BUILDING | <0.006 |
| DR0225-A22 | 6TH FLOOR FAN ROOM - RETURN AIR PLENUM - 425 BUILDING | <0.005 |
| DR0225-A23 | 5TH FLOOR FAN ROOM - RETURN AIR PLENUM - 425 BUILDING | <0.005 |
| DR0225-A24 | 4TH FLOOR FAN ROOM - RETURN AIR PLENUM - 425 BUILDING | 0.009 |
| DR0225-A25 | 4TH FLOOR FAN ROOM - OPEN RETURN AIR PLENUM - 415 BUILDING | <0.006 |
| DR0225-A26 | 3RD FLOOR - FAN ROOM - RETURN AIR PLENUM - 425 BUILDING | <0.007 |
| DR0225-A27 | 2ND FLOOR FAN ROOM - RETURN AIR PLENUM - 425 BUILDING | <0.008 |

STRUCTURES/CuCm = STRUCTURES PER CUBIC CENTIMETER.

MED-TOX ASSOCIATES, INC.

# APPENDIX A

## POLARIZED LIGHT MICROSCOPY LABORATORY REPORTS

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/1A-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224-1 | 70479 | Tan, crumbly, fibrous | ND(1) | 15 |
| JLB0224-2 | 70480 | Tan, crumbly, fibrous | 10 | ND(1) |
| JLB0224-3 | 70481 | Tan tile | ND(1) | ND(1)* |
| JLB0224-4 | 70482 | Gray, crumbly, fibrous 40% mineral wool | ND(1) | ND(1) |
| JLB0224-5 | 70483 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-6 | 70484 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-7 | 70485 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-8 | 70486 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-9 | 70487 | Gray, crumbly, fibrous | 5 | ND(1) |
| JLB0224-10 | 70488 | Tan tile | ND(1) | ND(1)* |

David L. Reusswig
David L. Reusswig
Laboratory Analyst

3/1/88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.
*Tile, vinyl, foam, plastic and fine powder samples may contain asbestos fibers of such small diameter that these fibers cannot be detected by PLM. For such samples more sensitive analytical methods, e.g. XRD, TEM, SEM, are recommended if greater certainty about asbestos content is required.

MED-TOX ASSOCIATES INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/2A-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224-11 | 70489 | Black vinyl with tan fibrous | ND(1) | ND(1)* |
| JLB0224-12 | 70490 | Pink tile | ND(1) | ND(1)* |
| JLB0224-13 | 70491 | Tan, crumbly, fibrous 10% cellulose | ND(1) | ND(1) |
| JLB0224-14 | 70492 | Tan, crumbly, fibrous 20% cellulose | ND(1) | ND(1) |
| JLB0224-15 | 70493 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-16 | 70494 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-17 | 70495 | Tan, crumbly, fibrous with vermiculite | 5 | ND(1) |
| JLB0224-18 | 70496 | White, crumbly, fibrous | 15 | 40 |
| JLB0224-19 | 70497 | White, crumbly, fibrous | 25 | 35 |
| JLB0224-20 | 70498 | White, crumbly, fibrous | 5 | 35 |

David L. Reusswig
Laboratory Analyst

3/1/88
Date

Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.
*Tile, vinyl, foam, plastic and fine powder samples may contain asbestos fibers of such small diameter that these fibers cannot be detected by PLM. For such samples more sensitive analytical methods, e.g. XRD, TEM, SEM, are recommended if greater certainty about asbestos content is required.

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/3A-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224-21 | 70499 | Yellow & brown fiberglass | ND(1) | ND(1) |
| JLB0224-22 | 70500 | Off-white plaster | ND(1) | ND(1) |
| JLB0224-23 | 70501 | White, crumbly, fibrous | 15 | 35 |
| JLB0224-24 | 70502 | Tan tile | 2 | ND(1)* |
| JLB0224-25 | 70503 | Tan, crumbly | ND(1) | ND(1) |
| JLB0224-26 | 70504 | Tan tile | Trace | ND(1)* |
| JLB0224-27 | 70505 | Brown tile | ND(1) | ND(1)* |
| JLB0224-28 | 70506 | Gray, crumbly, fibrous | 5 | ND(1) |
| JLB0224-29 | 70507 | Gray, crumbly, fibrous 45% fiberglass | ND(1) | ND(1) |
| JLB0224-30 | 70508 | Gray, crumbly, fibrous 60% fiberglass | ND(1) | ND(1) |
| JLB0224-31 | 70509 | Tan, crumbly | Trace | ND(1) |
| JLB0224-32 | 70510 | White, crumbly, fibrous | 10 | ND(1) |

David L. Reusswig
Laboratory Analyst

3/1/88
Date

Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.
*Tile, vinyl, foam, plastic and fine powder samples may contain asbestos fibers of such small diameter that these fibers cannot be detected by PLM. For such samples more sensitive analytical methods, e.g. XRD, TEM, SEM, are recommended if greater certainty about asbestos content is required.

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/94-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224-33 | 70511 | Black tar | 1 | ND(1) |
| JLB0224-34 | 70512 | Off-white, crumbly | 5 | ND(1) |
| JLB0224-35 | 70513 | Off-white, crumbly | 15 | ND(1) |
| JLB0224-36 | 70514 | Gray, fibrous tile | 40 | ND(1)* |
| JLB0224-37 | 70515 | Gray, fibrous tile | 50 | ND(1)* |
| JLB0224-38 | 70516 | Off-white, crumbly | ND(1) | ND(1) |
| JLB0224B-39 | 70517 | Off-white, crumbly, fibrous | 25 | 40 |
| JLB0224B-40 | 70518 | Tan, crumbly, fibrous | 30 | 30 |
| JLB0224B-41 | 70519 | White, crumbly | ND(1) | ND(1) |
| JLB0224B-42 | 70520 | Tan, crumbly, fibrous | 20 | 20 |
| JLB0224B-43 | 70521 | Off-white, crumbly, fibrous | 50 | 30 |
| JLB0224B-44 | 70522 | Off-white, crumbly, fibrous | 45 | 30 |
| JLB0224B-45 | 70523 | Off-white, crumbly, fibrous | 25 | 25 |
| JLB0224B-46 | 70524 | Off-white, crumbly, fibrous | 30 | 45 |
| JLB0224B-47 | 70525 | White plaster with vermiculite | ND(1) | ND(1) |

Julianne Rhodes/DLR
Julianne Rhodes
Laboratory Analyst

3/1/88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.
*Tile, vinyl, foam, plastic and fine powder samples may contain asbestos fibers of such small diameter that these fibers cannot be detected by PLM. For such samples more sensitive analytical methods, e.g. XRD, TEM, SEM, are recommended if greater certainty about asbestos content is required.

MED-TOX ASSOCIATES INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/95-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224B-48 | 70526 | White, crumbly, fibrous | 50 | 25 |
| JLB0224B-49 | 70527 | Tan, crumbly | ND(1) | ND(1) |
| JLB0224-50B | 70528 | Tan, crumbly with vermiculite | 20 | ND(1) |
| JLB0224-51B | 70529 | Tan, crumbly with vermiculite | 20 | ND(1) |
| JLB0224-52B | 70530 | Tan, crumbly with vermiculite | 25 | ND(1) |
| JLB0224-53B | 70531 | Tan, crumbly, fibrous with vermiculite | 25 | ND(1) |
| JLB0224-54B | 70532 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-55B | 70533 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-56B | 70534 | Tan, crumbly, fibrous with vermiculite | 25 | ND(1) |
| JLB0224-57B | 70535 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-58B | 70536 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-59B | 70537 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |

Julianne Rhodes/DLR
Julianne Rhodes
Laboratory Analyst

3/1/88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/26/88
MED-TOX JOB NO: 7L6459-3/96-3
PURCHASE ORDER NO: 3105

ANALYSIS: ASBESTOS IN BULK SAMPLES

METHOD: PLM (POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING)
EPA 600/M4-82-020

| Sample Identification Client | Lab No. | Brief Physical Description | Chrysotile Asbestos Percent | Amosite Asbestos Percent |
|---|---|---|---|---|
| JLB0224-60B | 70538 | Tan, crumbly, fibrous with vermiculite | 25 | ND(1) |
| JLB0224-61B | 70539 | Tan, crumbly, fibrous with vermiculite | 25 | ND(1) |
| JLB0224-62B | 70540 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-63B | 70541 | Tan, crumbly, fibrous with vermiculite | 30 | ND(1) |
| JLB0224-64B | 70542 | Tan, crumbly, fibrous with vermiculite | 25 | ND(1) |

Julianne Rhodes /DLK
Julianne Rhodes
Laboratory Analyst

3/1/88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
"ND(1)" means no asbestos detected; method detection limit is 1%.
"Trace" means asbestos identified in sample; concentration less than method detection limit of 1%.
Other asbestos minerals sought but not detected include crocidolite, anthophyllite, tremolite and actinolite.

1229 Morena Boulevard, San Diego, California 92110 (619) 276-8843

MED-TOX ASSOCIATES, INC.

# APPENDIX B

## PHASE CONTRAST MICROSCOPY LABORATORY REPORTS

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 SOUTH MAIN STREET
LOS ANGELES, CA 90013
ATTN: MR. PHIL MEYERS

REPORT DATE: 3/01/88
SAMPLES RECEIVED: 2/29/88
MED-TOX JOB NO: 7L6459-5/91-3
PURCHASE ORDER NO: 3105

ANALYSIS: FIBERS (>5 MICRONS LONG) ON 25mm FILTERS

METHOD: PCM (PHASE CONTRAST MICROSCOPY)
NIOSH 7400 "A" Counting Rules & OSHA/EPA REFERENCE METHOD

| Sample Identification Client | Lab No. | Sample Volume (liters) | Uncorrected Fiber Density (fibers/mm²) | Airborne Fiber Concentration (fibers/cm³) |
|---|---|---|---|---|
| DR0224-A1 | 70586 | 1650 | < 7.6 | < 0.002 |
| DR0224-A2 | 70587 | 1440 | < 7.6 | < 0.002 |
| DR0224-A3 | 70588 | 1800 | 25.5 | 0.005 |
| DR0224-A4 | 70589 | 1500 | 9.6 | 0.002 |
| DR0224-A5 | 70590 | 1450.4 | < 7.6 | < 0.002 |
| DR0224-A6 | 70591 | 1382.4 | < 7.6 | < 0.002 |
| DR0224-A7 | 70592 | 1595 | < 7.6 | < 0.002 |

Chris Surville
Chris Surville
Laboratory Analyst

3-3-88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
Fibers smaller than 0.3 microns in diameter are not detected by PCM.
PCM relative standard deviations range from 40% at low fiber density to 10% at high fiber density.
"<" means below reliable detection limit.
(#2) Detection limit based on a minimum fiber count of six.

1229 Morena Boulevard, San Diego, California 92110 (619) 276-8843

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
ATTN: PHIL MEYERS

REPORT DATE: 3/8/88
SAMPLES RECEIVED: 3/3/88
MED-TOX JOB NO:7L-6459-6/WP42
PURCHASE ORDER NO: 3105

ANALYSIS: FIBERS (>5 MICRONS LONG) ON 25mm FILTERS

METHOD: PCM (PHASE CONTRAST MICROSCOPY)
NIOSH 7400 "A" Counting Rules & OSHA/EPA REFERENCE METHOD

| Sample Identification | | Sample Volume | Uncorrected Fiber Density | Airborne Fiber Concentration |
|---|---|---|---|---|
| Client | Lab No. | (liters) | (fibers/mm²) | (fibers/cm³) |
| DR0225-A8 | 70685 | 1870 | <7.6 | <0.002,#8 |
| DR0225-A9 | 70686 | 1680 | <7.6 | <0.002,#8 |
| DR0225-A10 | 70687 | 1947 | <7.6 | <0.002,#8 |
| DR0225-A11 | 70688 | 1627 | <7.6 | <0.002,#8 |
| DR0225-A12 | 70689 | 2012 | <7.6 | <0.001,#8 |
| DR0225-A13 | 70690 | 1958 | <7.6 | <0.002,#8 |
| DR0225-A14 | 70691 | 1936 | 40.1 | 0.008,#8 |
| DR0225-A15 | 70692 | 3130 | <7.6 | <0.0009,#8 |
| DR0225-A16 | 70693 | 2825 | <7.6 | <0.001,#8 |
| DR0225-A17 | 70694 | 2575 | <7.6 | <0.001,#8 |
| DR0225-A18 | 70695 | 2750 | <7.6 | <0.001,#8 |
| DR0225-A19 | 70696 | 2940 | <7.6 | <0.001,#8 |
| DR0225-A20 | 70697 | 3186 | 7.6 | 0.0009,#8 |
| DR0225-A28 | 70705 | 2124 | <7.6 | <0.001 |
| DR0225-A29 | 70706 | 1860 | <7.6 | <0.002 |
| DR0225-A30 | 70707 | 1617 | <7.6 | <0.002 |
| DR0225-A31 | 70708 | 1299 | <7.6 | <0.002 |
| DR0225-A32 | 70709 | 1184 | 9.6 | 0.003 |
| DR0225-A33 | 70710 | 1299 | <7.6 | <0.002 |

Chris Surville
CHRIS SURVILLE
Laboratory Analyst

3-8-88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
Fibers smaller than 0.3 microns in diameter are not detected by PCM.
PCM relative standard deviations range from 40% at low fiber density to 10% at high fiber density.
"<" means below reliable detection limit.
(#8) Heavy particulate loading may have obscured samller fibers.

MED-TOX ASSOCIATES, INC.

# LABORATORY REPORT

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
ATTN: PHIL MEYERS

REPORT DATE: 3/8/88
SAMPLES RECEIVED: 3/3/88
MED-TOX JOB NO:7L-6459-6/WP42
PURCHASE ORDER NO: 3105

ANALYSIS: FIBERS (>5 MICRONS LONG) ON 25mm FILTERS

METHOD: PCM (PHASE CONTRAST MICROSCOPY)
NIOSH 7400 "A" Counting Rules & OSHA/EPA REFERENCE METHOD

| Sample Identification Client | Lab No. | Sample Volume (liters) | Uncorrected Fiber Density (fibers/mm²) | Airborne Fiber Concentration (fibers/cm³) |
|---|---|---|---|---|
| DR0225-A34 | 70711 | 937 | <7.6 | <0.003 |
| DR0225-A35 | 70712 | 880 | <7.6 | <0.003 |
| DR0225-A36 | 70713 | 847 | <7.6 | <0.003 |
| DR0225-A37 | 70714 | 720 | <7.6 | <0.004 |
| DR0225-A38 | 70715 | 715 | <7.6 | <0.004 |
| DR0225-A39 | 70716 | 768 | <7.6 | <0.004 |
| DR0225-A40 | 70717 | 715 | <7.6 | <0.004 |
| DR0226-A41 | 70718 | 1265 | 7.6 | 0.002 |
| DR0226-A42 | 70719 | 1243 | <7.6 | <0.002 |
| DR0226-A43 | 70720 | 1356 | <7.6 | <0.002 |
| DR0226-A44 | 70721 | 1210 | 20.4 | 0.006,#8 |
| DR0226-A45 | 70722 | 1141 | 14.6 | 0.005 |
| DR0226-A46 | 70723 | 1210 | <7.6 | <0.002 |
| DR0226-A47 | 70724 | 1144 | <7.6 | <0.003 |
| DR0226-A48 | 70725 | 1288 | 10.2 | 0.003 |
| DR0226-A49 | 70726 | 1209 | 7.6 | 0.002 |
| DR0226-A50 | 70727 | 1001 | 14.0 | 0.005 |
| DR0226-A51 | 70728 | 1039 | <7.6 | <0.003 |
| DR0226-A52 | 70729 | 880 | 8.3 | 0.004 |
| DR0226-A53 | 70730 | 836 | <7.6 | <0.004 |
| DR0226-A54 | 70731 | 825 | <7.6 | <0.004 |

Chris Surville
CHRIS SURVILLE
Laboratory Analyst

3-8-88
Date

Tom Dagenhart
Tom Dagenhart, M.S.
Laboratory Manager

NOTES:
Fibers smaller than 0.3 microns in diameter are not detected by PCM.
PCM relative standard deviations range from 40% at low fiber density to 10% at high fiber density.
"<" means below reliable detection limit.
(#8) Heavy particulate loading may have obscured samller fibers.

1229 Morena Boulevard, San Diego, California 92110 (619) 276-8843

MED-TOX ASSOCIATES, INC.

# APPENDIX C

## TRANSMISSION ELECTRON MICROSCOPY LABORATORY REPORTS

# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A21
Med-Tox Number: 70698
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING, SOME FIBERS MAY HAVE BEEN OBSCURED.

Analytical Sensitivity : 0.0015 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2475.0 liters
Total number of structs : 3
Filter type : 0.4 um, polycarbonate
Conductive Coat : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.006 (structures/cu cm) | < 0.006 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.000 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Structure Conc. (structures/cu cm) | | | | | |
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.003 | 0.003 |
| Mass Concentration (ng/cu meter) | | | | | |
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.013 | 0.013 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst [signature] Date 3/7/88

Lab Manager Tom Eggenhuisen Date 3/7/88



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A21
Med-Tox Number: 70698
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING, SOME FIBERS MAY HAVE BEEN OBSCURED.

Analytical Sensitivity : 0.0015 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2475.0 liters
Total number of structs : 1
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures * |
|---|---|---|
| Total Concentration | < 0.006 (structures/cu cm) | < 0.006 (structures/cu cm) |

* Because of heavy non-asbestos fiber loadings, only asbestos and indeterminant fibers were recorded in order to improve detection limits. Therefore these TEM results are not strictly comparable with PCM results.

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.002 | 0.000 | 0.000 | 0.002 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA
EPA Level I Method (Yanate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A21
Med-Tox Number: 70698

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| No Structures Detected in This Category. | | | | | |

Detailed Data For Structures Classified as BUNDLES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 0 | 0 | 0 | 1 |
| Total Surface Area (sq um/cu meter) | | 0.0 | 0.0 | 0.0 | 17276.3 |
| Length | geometric mean | 0.0000 | 0.0000 | 0.0000 | 7.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0000 | 0.0000 | 0.0000 | 0.5000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as CLUMPS:

| | | | | | |
|---|---|---|---|---|---|
| No Structures Detected in This Category. | | | | | |

Detailed Data For Structures Classified as MATRICES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 0 | 0 | 2 | 0 |
| Total Surface Area (sq um/cu meter) | | 0.0 | 0.0 | 417.0 | 0.0 |
| Length | geometric mean | 0.0000 | 0.0000 | 0.8367 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.2130 | 0.0000 |
| Diameter | geometric mean | 0.0000 | 0.0000 | 0.0500 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 0 | 0 | 2 | 1 |
| Total Surface Area (sq um/cu meter) | | 0.0 | 0.0 | 417.0 | 17276.3 |
| Length | geometric mean | 0.0000 | 0.0000 | 0.8367 | 7.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.2130 | 0.0000 |
| Diameter | geometric mean | 0.0000 | 0.0000 | 0.0500 | 0.5000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |



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AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DRO225-A21
Med-Tox Number: 70698

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 2 | 1 | matrix | 0.05 | 0.70 | 3.57 | 1 | indeterminant |
| 2 | 2 | matrix | 0.05 | 1.00 | 5.11 | 1 | indeterminant |
| 6 | 1 | bundle | 0.50 | 7.00 | 3573.56 | 3 | nonasbestos |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.

# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A22
Med-Tox Number: 70699
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING.

Analytical Sensitivity : 0.0013 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2970.0 liters
Total number of structs : 1
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.005 (structures/cu cm) | < 0.005 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.02 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Structure Conc. (structures/cu cm) | | | | | |
| Chrysotile | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mass Concentration (ng/cu meter) | | | | | |
| Chrysotile | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| Amphibole | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Indeterminant | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst Tom Eisenhart Date 3/7/88

Lab Manager Tom Eisenhart Date 3/7/88



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A22
Med-Tox Number: 70699
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING.

Analytical Sensitivity : 0.0013 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2970.0 liters
Total number of structs : 0
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures * |
|---|---|---|
| Total Concentration | < 0.005 (structures/cu cm) | < 0.005 (structures/cu cm) |

* Because of heavy non-asbestos fiber loadings, only asbestos and indeterminant fibers were recorded in order to improve detection limits. Therefore these TEM results are not strictly comparable with PCM results.

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthopnyllite, tremolite and actinolite.



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A22
Med-Tox Number: 70699

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Asphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 0 | 0 | 0 |
| Total Surface Area (sq um/cu meter) | | 481.6 | 0.0 | 0.0 | 0.0 |
| Length | geometric mean | 2.4000 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0500 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as BUNDLES:

No Structures Detected in This Category.

Detailed Data For Structures Classified as CLUMPS:

No Structures Detected in This Category.

Detailed Data For Structures Classified as MATRICES:

No Structures Detected in This Category.

---

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 0 | 0 | 0 |
| Total Surface Area (sq um/cu meter) | | 481.6 | 0.0 | 0.0 | 0.0 |
| Length | geometric mean | 2.4000 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0500 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A22
Med-Tox Number: 70699

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 2 | 1 | fiber | 0.05 | 2.40 | 12.25 | 1 | chrysotile |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yanate et al.; 1984)

MED-TOX ASSOCIATES, INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A23
Med-Tox Number: 70700
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING.

Analytical Sensitivity : 0.0014 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2750.0 liters
Total number of structs : 3
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.005 (structures/cu cm) | < 0.005 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.000 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Structure Conc. (structures/cu cm) | | | | | |
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Mass Concentration (ng/cu meter) | | | | | |
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.045 | 0.000 | 0.000 | 0.000 | 0.045 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst [signature] Date 3/2/88

Lab Manager Tom Eaglehart Date 3/7/88



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A23
Med-Tox Number: 70700
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

HEAVY PARTICULATE LOADING.

Analytical Sensitivity : 0.0014 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2750.0 liters
Total number of structs : 0
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures |
|---|---|---|
| Total Concentration | < 0.005 (structures/cu cm) | < 0.005 (structures/cu cm) |

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A23
Med-Tox Number: 70700

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 0 | 0 | 1 | 2 |
| Total Surface Area (sq um/cu meter) | | 0.0 | 0.0 | 707.7 | 1512.0 |
| Length | geometric mean | 0.0000 | 0.0000 | 1.6000 | 1.0954 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.1416 |
| Diameter | geometric mean | 0.0000 | 0.0000 | 0.1000 | 0.1500 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as BUNDLES:

No Structures Detected in This Category.

Detailed Data For Structures Classified as CLUMPS:

No Structures Detected in This Category.

Detailed Data For Structures Classified as MATRICES:

No Structures Detected in This Category.

---

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 0 | 0 | 1 | 2 |
| Total Surface Area (sq um/cu meter) | | 0.0 | 0.0 | 707.7 | 1512.0 |
| Length | geometric mean | 0.0000 | 0.0000 | 1.6000 | 1.0954 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.1416 |
| Diameter | geometric mean | 0.0000 | 0.0000 | 0.1000 | 0.1500 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A23
Med-Tox Number: 70700

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 5 | 1 | fiber | 0.10 | 1.60 | 32.67 | 1 | indeterminant |
| 6 | 1 | fiber | 0.15 | 1.80 | 45.95 | 1 | nonasbestos |
| 8 | 1 | fiber | 0.15 | 1.20 | 55.13 | 1 | nonasbestos |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.



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AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES, INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A24
Med-Tox Number: 70701
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

LIGHT PARTICULATE LOADING,
SOME GYPSUM CHUNKS SEEN.

Analytical Sensitivity : 0.0015 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 19400 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2508.0 liters
Total number of structs : 10
Filter type : 0.8 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | 0.009 (structures/cu cm) | < 0.006 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.1 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Structure Conc. (structures/cu cm) | | | | | |
| Chrysotile | 0.003 | 0.003 | 0.001 | 0.000 | 0.007 |
| Amphibole | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Indeterminant | 0.003 | 0.000 | 0.000 | 0.000 | 0.003 |
| Mass Concentration (ng/cu meter) | | | | | |
| Chrysotile | 0.01 | 0.04 | 0.04 | 0.00 | 0.09 |
| Amphibole | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 |
| Indeterminant | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst Tom Eggenhart Date 3/7/88
Lab Manager Tom Eggenhart Date 3/7/88



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MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A24
Med-Tox Number: 70701
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

LIGHT PARTICULATE LOADING,
SOME GYPSUM CHUNKS SEEN.

Analytical Sensitivity : 0.0015 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 19400 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2508.0 liters
Total number of structs : 1
Filter type : 0.8 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures * |
|---|---|---|
| Total Concentration | < 0.006 (structures/cu cm) | < 0.006 (structures/cu cm) |

* Because of heavy non-asbestos fiber loadings, only asbestos and indeterminant fibers were recorded in order to improve detection limits. Therefore these TEM results are not strictly comparable with PCM results.

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.



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AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A24
Med-Tox Number: 70701

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| **Detailed Data For Structures Classified as FIBERS:** | | | | | |
| Total Number of Structures Counted | | 2 | 1 | 2 | 0 |
| Total Surface Area (sq um/cu meter) | | 379.5 | 682.0 | 452.7 | 0.0 |
| Length | geometric mean | 0.6481 | 1.4000 | 0.6325 | 0.0000 |
| | standard deviation | 0.8286 | 0.0000 | 0.2136 | 0.0000 |
| Diameter | geometric mean | 0.0387 | 0.1000 | 0.0707 | 0.0000 |
| | standard deviation | 0.0143 | 0.0000 | 0.0359 | 0.0000 |
| **Detailed Data For Structures Classified as BUNDLES:** | | | | | |
| Total Number of Structures Counted | | 2 | 0 | 0 | 2 |
| Total Surface Area (sq um/cu meter) | | 658.4 | 0.0 | 0.0 | 58818.9 |
| Length | geometric mean | 0.6000 | 0.0000 | 0.0000 | 2.4495 |
| | standard deviation | 0.3606 | 0.0000 | 0.0000 | 5.3130 |
| Diameter | geometric mean | 0.1000 | 0.0000 | 0.0000 | 0.4743 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 1.0757 |
| **Detailed Data For Structures Classified as CLUMPS:** | | | | | |
| Total Number of Structures Counted | | 1 | 0 | 0 | 0 |
| Total Surface Area (sq um/cu meter) | | 1234.6 | 0.0 | 0.0 | 0.0 |
| Length | geometric mean | 0.5000 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0500 | 0.0000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Detailed Data For Structures Classified as MATRICES:**

No Structures Detected in This Category.

---

**DETAILED DATA FOR ALL STRUCTURES:**

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 5 | 1 | 2 | 2 |
| Total Surface Area (sq um/cu meter) | | 2272.6 | 682.0 | 452.7 | 58818.9 |
| Length | geometric mean | 0.5966 | 1.4000 | 0.6325 | 2.4495 |
| | standard deviation | 0.4648 | 0.0000 | 0.2136 | 5.3130 |
| Diameter | geometric mean | 0.0596 | 0.1000 | 0.0707 | 0.4743 |
| | standard deviation | 0.0325 | 0.0000 | 0.0359 | 1.0757 |

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A24
Med-Tox Number: 70701

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 1 | 1 | bundle | 0.15 | 0.80 | 36.76 | 2 | nonasbestos |
| 1 | 2 | bundle | 1.50 | 7.50 | 34459.34 | 2 | nonasbestos |
| 1 | 3 | fiber | 0.10 | 1.40 | 32.99 | 1 | amphibole |
| 1 | 4 | bundle | 0.10 | 0.40 | 8.17 | 2 | chrysotile |
| 2 | 1 | fiber | 0.10 | 0.50 | 10.21 | 1 | indeterminant |
| 5 | 1 | fiber | 0.05 | 0.80 | 4.08 | 1 | indeterminant |
| 6 | 1 | fiber | 0.05 | 1.40 | 7.15 | 1 | chrysotile |
| 7 | 1 | fiber | 0.03 | 0.30 | 0.55 | 1 | chrysotile |
| 9 | 1 | clump | 0.05 | 0.50 | 25.53 | 10 | chrysotile |
| 10 | 1 | bundle | 0.10 | 0.90 | 18.38 | 4 | chrysotile |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.



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# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A25
Med-Tox Number: 70702
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

Analytical Sensitivity : 0.0014 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2645.0 liters
Total number of structs : 3
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.006 (structures/cu cm) | < 0.006 (structures/cu cm) |
| Total Asbestos Mass Concentration | 20.1 (ng/cu meter) | 20.1 (ng/cu meter) |

Additional Information by Structure Type

| Structure Conc. (structures/cu cm) | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Amphibole | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Indeterminant | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| **Mass Concentration (ng/cu meter)** | | | | | |
| Chrysotile | 0.03 | 0.00 | 0.00 | 0.00 | 0.03 |
| Amphibole | 20.07 | 0.00 | 0.00 | 0.00 | 20.07 |
| Indeterminant | 0.03 | 0.00 | 0.00 | 0.00 | 0.03 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst _____ Date 3/7/88

Lab Manager Tom Eapenhart Date 3/7/88



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

MED-TOX ASSOCIATES, INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A25
Med-Tox Number: 70702
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

Analytical Sensitivity : 0.0014 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2645.0 liters
Total number of structs : 1
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures |
|---|---|---|
| Total Concentration | < 0.006 (structures/cu cm) | < 0.006 (structures/cu cm) |

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A25
Med-Tox Number: 70702

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 1 | 1 | 0 |
| Total Surface Area (sq um/cu meter) | | 468.3 | 54072.1 | 468.3 | 0.0 |
| Length | geometric mean | 1.0000 | 24.0000 | 1.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.1000 | 0.5000 | 0.1000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as BUNDLES:

No Structures Detected in This Category.

Detailed Data For Structures Classified as CLUMPS:

No Structures Detected in This Category.

Detailed Data For Structures Classified as MATRICES:

No Structures Detected in This Category.

---

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 1 | 1 | 0 |
| Total Surface Area (sq um/cu meter) | | 468.3 | 54072.1 | 468.3 | 0.0 |
| Length | geometric mean | 1.0000 | 24.0000 | 1.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.1000 | 0.5000 | 0.1000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yanata et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A25
Med-Tox Number: 70702

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 2 | 1 | fiber | 0.10 | 1.00 | 20.42 | 1 | indeterminant |
| 4 | 1 | fiber | 0.10 | 1.00 | 20.42 | 1 | chrysotile |
| 7 | 1 | fiber | 0.50 | 24.00* | 14137.17 | 1 | amphibole |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.

* indicates estimated length, fiber end obscured by grid boundary.



Med-Tox Associates, Inc. 1229 Morena Blvd San Diego, CA 92110 619-276-8843

# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A26
Med-Tox Number: 70703
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

Analytical Sensitivity : 0.0018 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2090.0 liters
Total number of structs : 2
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.007 (structures/cu cm) | < 0.007 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.1 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Structure Conc. (structures/cu cm) | | | | | |
| Chrysotile | 0.002 | 0.000 | 0.000 | 0.000 | 0.002 |
| Amphibole | 0.002 | 0.000 | 0.000 | 0.000 | 0.002 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mass Concentration (ng/cu meter) | | | | | |
| Chrysotile | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| Amphibole | 0.14 | 0.00 | 0.00 | 0.00 | 0.14 |
| Indeterminant | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst _____ Date 3/7/88

Lab Manager _____ Date 3/7/88



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MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A26
Med-Tox Number: 70703
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

Analytical Sensitivity : 0.0018 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 2090.0 liters
Total number of structs : 0
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures |
|---|---|---|
| Total Concentration | < 0.007 (structures/cu cm) | < 0.007 (structures/cu cm) |

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.



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AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A26
Med-Tox Number: 70703

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 1 | 0 | 0 |
| Total Surface Area (sq um/cu meter) | | 402.1 | 1015.9 | 0.0 | 0.0 |
| Length | geometric mean | 1.4000 | 0.8000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0500 | 0.2000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as BUNDLES:

No Structures Detected in This Category.

Detailed Data For Structures Classified as CLUMPS:

No Structures Detected in This Category.

Detailed Data For Structures Classified as MATRICES:

No Structures Detected in This Category.

---

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 1 | 0 | 0 |
| Total Surface Area (sq um/cu meter) | | 402.1 | 1015.9 | 0.0 | 0.0 |
| Length | geometric mean | 1.4000 | 0.8000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.0500 | 0.2000 | 0.0000 | 0.0000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC.

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A26
Med-Tox Number: 70703

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 1 | 1 | fiber | 0.20 | 0.80 | 75.40 | 1 | amphibole |
| 5 | 1 | fiber | 0.05 | 1.40 | 7.15 | 1 | chrysotile |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.



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# AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM)

EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A27
Med-Tox Number: 70704
Receipt Date : MARCH 3, 1988
Report Date : MARCH 7, 1988
Description :

Analytical Sensitivity : 0.0020 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 1920.0 liters
Total number of structs : 3
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

ASBESTOS SUMMARY

| | All Structures | Only > 5 um Structures |
|---|---|---|
| Total Asbestos Structure Concentration | < 0.008 (structures/cu cm) | < 0.008 (structures/cu cm) |
| Total Asbestos Mass Concentration | 0.06 (ng/cu meter) | 0.000 (ng/cu meter) |

Additional Information by Structure Type

| Structure Conc. (structures/cu cm) | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.002 | 0.000 | 0.000 | 0.000 | 0.002 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.002 | 0.000 | 0.000 | 0.000 | 0.002 |
| **Mass Concentration (ng/cu meter)** | | | | | |
| Chrysotile | 0.06 | 0.00 | 0.00 | 0.00 | 0.06 |
| Amphibole | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Indeterminant | 0.11 | 0.00 | 0.00 | 0.00 | 0.11 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

Analyst _____ Date 3/7/88

Lab Manager Tom Legendre Date 3/7/88



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Job Number : 7L-6459-6/1A-3105
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Description :

Analytical Sensitivity : 0.0020 (structures/cu cm)
Total Area Scanned : 102540 sq um
Magnification : 20000 x
Area of Original Filter : 3.85 sq cm
Dilution Factor : <not ashed>
Area Ashed : <not ashed>
Area of Membrane : <not ashed>
Volume of Air : 1920.0 liters
Total number of structs : 0
Filter type : 0.4 um, polycarbonate
Conductive Cowl : no

Dimensional Limitations:

Only structures with diameters greater than 0.3 um and lengths greater than 5.0 um are included in the data subset used to calculate the following results.

| | Asbestos Structures | All Structures |
|---|---|---|
| Total Concentration | < 0.008 (structures/cu cm) | < 0.008 (structures/cu cm) |

Structure Concentrations by Structure Type
(structures/cu cm)

| | Fiber | Bundle | Clump | Matrix | TOTAL |
|---|---|---|---|---|---|
| Chrysotile | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amphibole | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Indeterminant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Asbestos | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- The method detection limit is 4 times the analytical sensitivity. Analytical sensitivity is defined by the EPA as the asbestos concentration represented by each fiber counted under the electron microscope.
- TEM data is accurate to no more than one significant figure.
- Structures per cubic centimeter equals million structures per cubic meter.
- Amphibole asbestos includes amosite (i.e. grunerite - cummingtonite), crocidolite (i.e. riebeckite - magnesioriebeckite), anthophyllite, tremolite and actinolite.

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DIMENSIONAL DATA
EPA Level I Method (Yanate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A27
Med-Tox Number: 70704

Detailed Data For Structures Classified as FIBERS:

| | | Chrysotile | Amphibole | Indeterminant | Nonasbestos |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 0 | 1 | 1 |
| Total Surface Area (sq um/cu meter) | | 890.8 | 0.0 | 1174.9 | 2088.8 |
| Length | geometric mean | 1.4000 | 0.0000 | 1.2000 | 1.6000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.1000 | 0.0000 | 0.1500 | 0.2000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Detailed Data For Structures Classified as BUNDLES:

No Structures Detected in This Category.

Detailed Data For Structures Classified as CLUMPS:

No Structures Detected in This Category.

Detailed Data For Structures Classified as MATRICES:

No Structures Detected in This Category.

---

DETAILED DATA FOR ALL STRUCTURES:

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Structures Counted | | 1 | 0 | 1 | 1 |
| Total Surface Area (sq um/cu meter) | | 890.8 | 0.0 | 1174.9 | 2088.8 |
| Length | geometric mean | 1.4000 | 0.0000 | 1.2000 | 1.6000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Diameter | geometric mean | 0.1000 | 0.0000 | 0.1500 | 0.2000 |
| | standard deviation | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AIRBORNE ASBESTOS ANALYSIS BY TRANSMISSION ELECTRON MICROSCOPY (TEM) - DATA LISTING
EPA Level I Method (Yamate et al.; 1984)

MED-TOX ASSOCIATES INC

S.C.R.T.D.
425 S. MAIN ST.
LOS ANGELES, CA 90013
PHIL MEYERS

Job Number : 7L-6459-6/1A-3105
Client Number : DR0225-A27
Med-Tox Number: 70704

| Field No. | Structure No. per Field | Structure Type | Diameter (microns) | Length (microns) | Mass per Structure (fg) | Fibers per Structure | Structure Identification |
|---|---|---|---|---|---|---|---|
| 3 | 1 | fiber | 0.20 | 1.60 | 130.69 | 1 | nonasbestos |
| 5 | 1 | fiber | 0.10 | 1.40 | 28.59 | 1 | chrysotile |
| 9 | 1 | fiber | 0.15 | 1.20 | 55.13 | 1 | indeterminant |

- um = micron, a micron is one millionth of a meter.
- ng = nanogram, a nanogram is one billionth of a gram.
- fg = femtogram, a femtogram is one millionth of a nanogram.
- Masses of indeterminate and non-asbestos fibers are estimated by assuming a density of 2.6 grams per cubic centimeter.



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# APPENDIX D

# PHOTOGRAPHS

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# APPENDIX E

# ASBESTOS MANAGEMENT PROGRAM

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# APPENDIX E
# ASBESTOS MANAGEMENT PROGRAM

## I. GENERAL OUTLINE

The following is an outline of the Elements of an Asbestos Management Program.

### A) GENERAL ASBESTOS INFORMATION

- Properties
- Health Hazards
- Exposure Risks

### B) POLICIES

- Policy Statement
- Responsibilities (Department/Individual)

### C) PROGRAM STRUCTURE

- Regulatory Compliance (Federal, State, Local)
- Training (Hazardous Communication Program)
- Medical Surveillance Program
- Air Monitoring Program
- Risk Management Program
- Respiratory Protection Program
- Emergency Response Program
- Recordkeeping Program

### D) ADMINISTRATIVE CONTROLS

- Operations and Maintenance Manual
  (Refer to Operations and Maintenance Program)
- "Contractor Assistance" Program

### E) ABATEMENT OPTIONS

- Removal Program
- Encapsulation Program
- Enclosure Program

## II. ABATEMENT OPTIONS

The abatement options provided to building management for asbestos control measures are enclosure, encapsulation, removal and/or administrative controls.

A) Enclosure involves constructing a sealed barrier around the asbestos containing material. This may, in some cases, be the most rapid and economical approach, but it cannot be used where entry into the enclosure is necessary; where there is a chance of water damage to the enclosure, or where the asbestos material is damaged or rapidly deteriorating.

B) Encapsulation involves spraying a sealant over the asbestos containing material and can effectively stop the release of fibers. However, this method is considered a temporary solution for asbestos abatement. The material must be strong enough to support the weight of the sealant and in an area where water damage is unlikely.

It should be recognized that both enclosure and encapsulation must be followed with a management control program, including periodic reinspection of the materials to ensure the integrity. In addition, these control methods have the disadvantage of making removal more difficult, should the decision to remove the asbestos become necessary.

C) Removal has the widest applicability of all control alternatives, and is a permanent solution for asbestos abatement. As with other types of abatement options, removal must be performed by a licensed and qualified asbestos abatement contractor. Specialized processes and equipment are required during all removal projects. Careful attention to asbestos control and removal is required during all phases of the removal project.

D) Administrative Controls require establishing procedures for recording the ACM conditions and that they have been inspected at pre-determined intervals; after any non-controlled ACM disturbance; and before, during and after any maintenance, custodial or contractor work which has potential for ACM disturbance. When damage or delamination is detected, corrective action can be planned accordingly. The records of inspection should include a photograph in conjunction with the date of inspection, results from any air monitoring conducted (when necessary), and the name of the person(s) responsible for the inspection. It is not a program of avoiding action, but rather of verifying that deterioration has not occurred and that no further action is required in a particular area.

## III. OPERATIONS AND MAINTENANCE PROGRAM

As a general recommendation, and a subsequent inclusion to administrative controls, while ACM exists in any facility and until its removal, an Operations and Maintenance (O & M) Program should be implemented. The elements of such a program should consist of the following.

1. Appoint an Asbestos Control Program Manager, whose responsibilities include:

   - o developing scope and funding requirements for the program
   - o contacting appropriate technical experts and health professionals to administer the program
   - o training the supervising control program staff and providing for education of employees (Training Level I and II)
   - o identifying, labeling and periodic evaluation of potential asbestos hazards
   - o determining abatement priorities, if deemed necessary, and implementing ingredients of short or long term control programs
   - o evaluating the alternative options of ACM control and arranging for qualified contractors to perform abatement when necessary
   - o identifying any employees to be included in a medical surveillance program
   - o implementing a comprehensive recordkeeping and reporting system.

2. Minimize access and exposure to all known ACM at each facility by informing all affected personnel of its location, and instructing them to report any damage to the ACM they observe. In addition, precautionary signs should be posted at entrances of areas containing friable ACM which is damaged and exposed. OSHA specified warning labels should be affixed to the ACM, so as to preclude accidental disruption. Through normal maintenance activities there is a possibility of contact or disturbance.

3. Document inspection of all ACM at least twice a year for damage and/or deterioration.

4. Level I training for administrative and affected personnel and Level II training for custodial and maintenance employees.

5. Spot removal or abatement by a licensed asbestos abatement contractor.

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## IV. PERIODIC AIR MONITORING SURVEILLANCE

Renovations, building vibration, damage to materials from accidental or mechanical contact, and aging of materials can alter the fiber release potential of asbestos containing materials. It is necessary to perform air monitoring in areas with moderately damaged ACM. In order to maintain the cost-effectiveness of periodic monitoring, follow-up air samples may be analyzed by Phase Contrast Microscopy (PCM). This method provides sufficient analytical sensitivity to detect airborne fiber concentrations at 0.01 fiber/cc and above. Employed as a screening tool, the results of PCM analysis can then be used to indicate which areas should be re-evaluated by Transmission Electron Microscopy.

Areas with no or slightly damaged ACM, should be qualitatively re-evaluated on an ongoing basis by means of a hazard assessment. They do not require monitoring by air sampling unless their hazard assessment indicates that material has been subsequently damaged.

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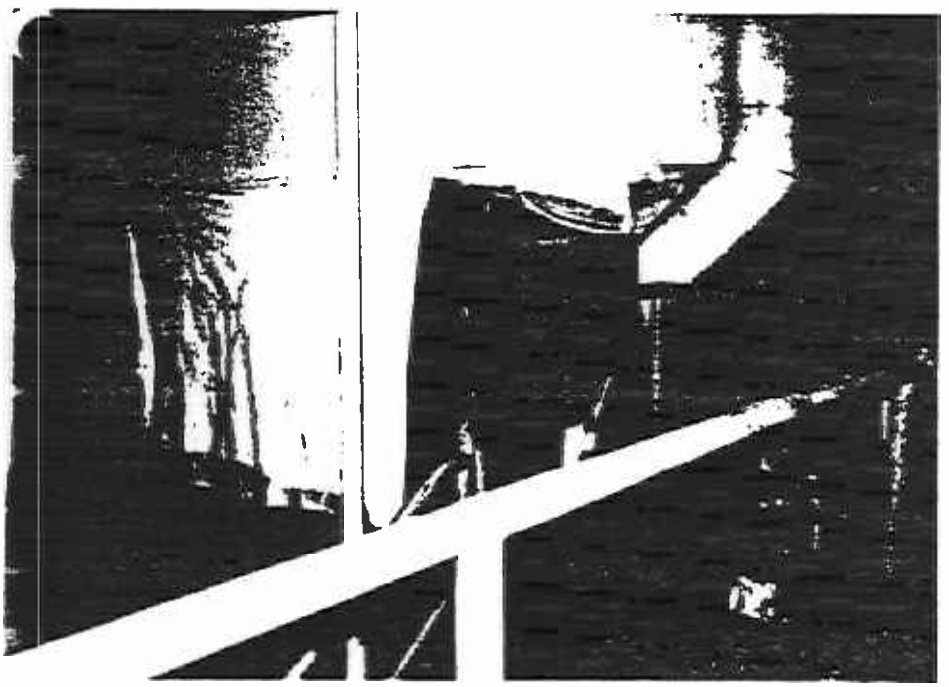
# APPENDIX F

# FEDERAL OSHA ASBESTOS STANDARD

CLOTH DAMAGE A7
MAIN EXHAUST DUCT
BOILER ROOM



CLOTH DAMAGE AT
MAIN EXHAUST DUCT
BOILER ROOM

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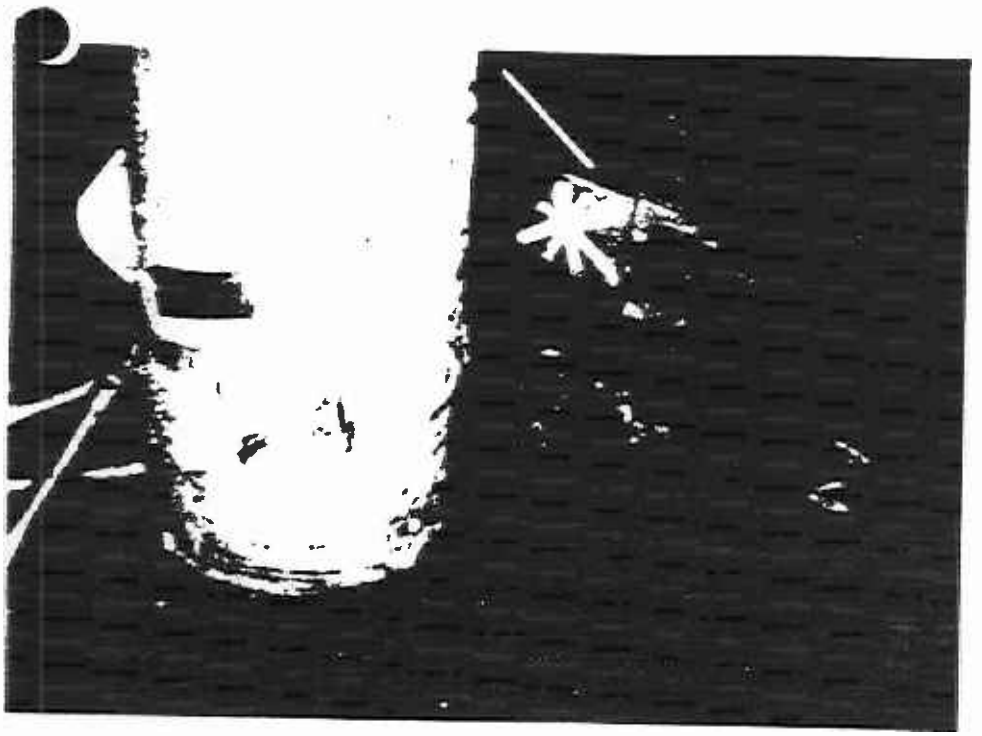
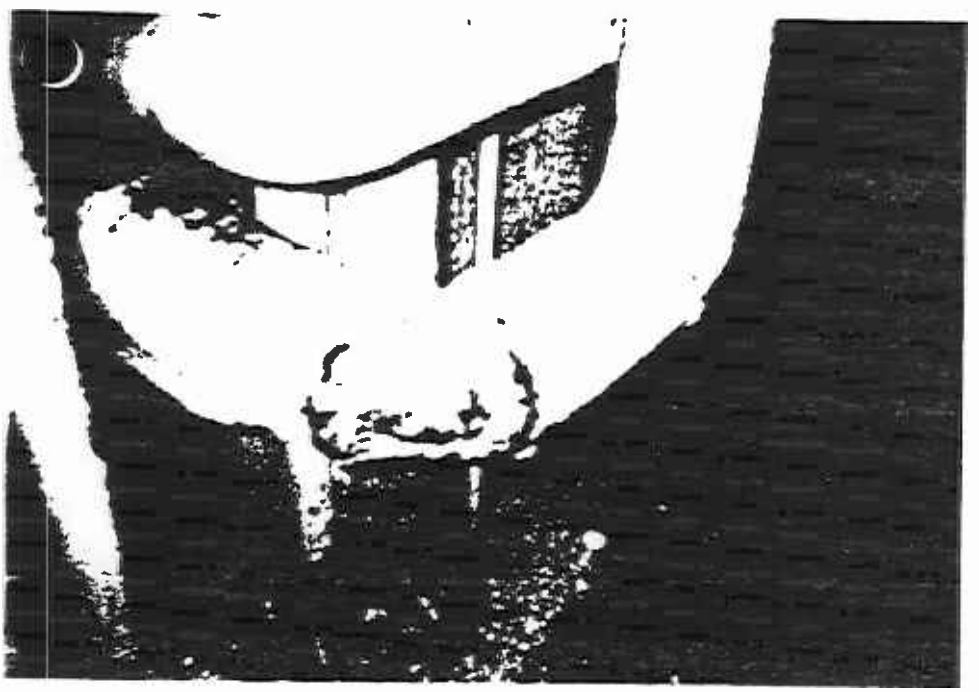
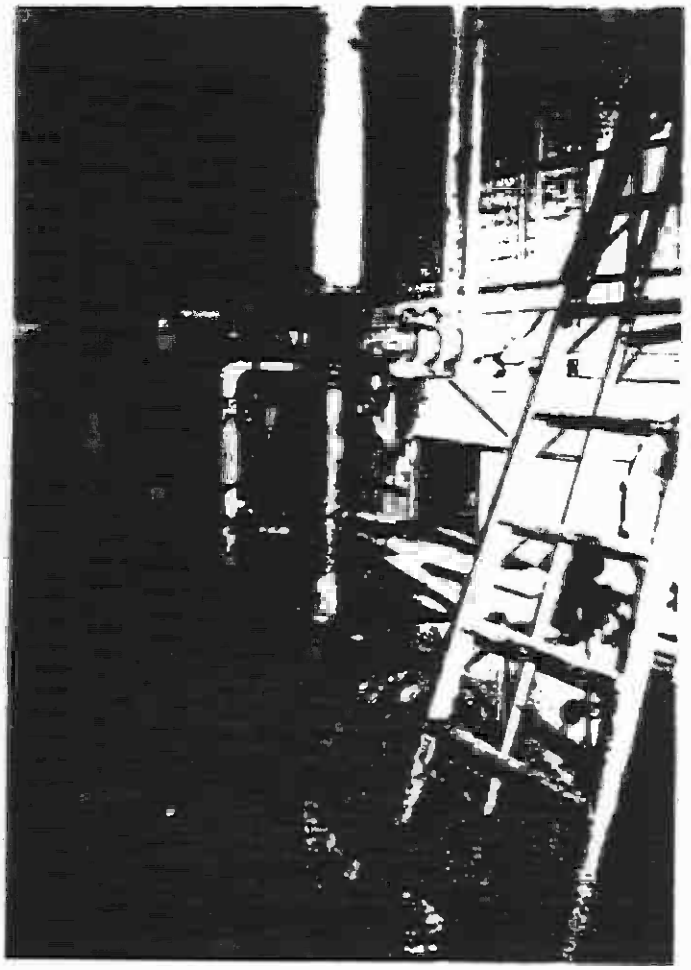


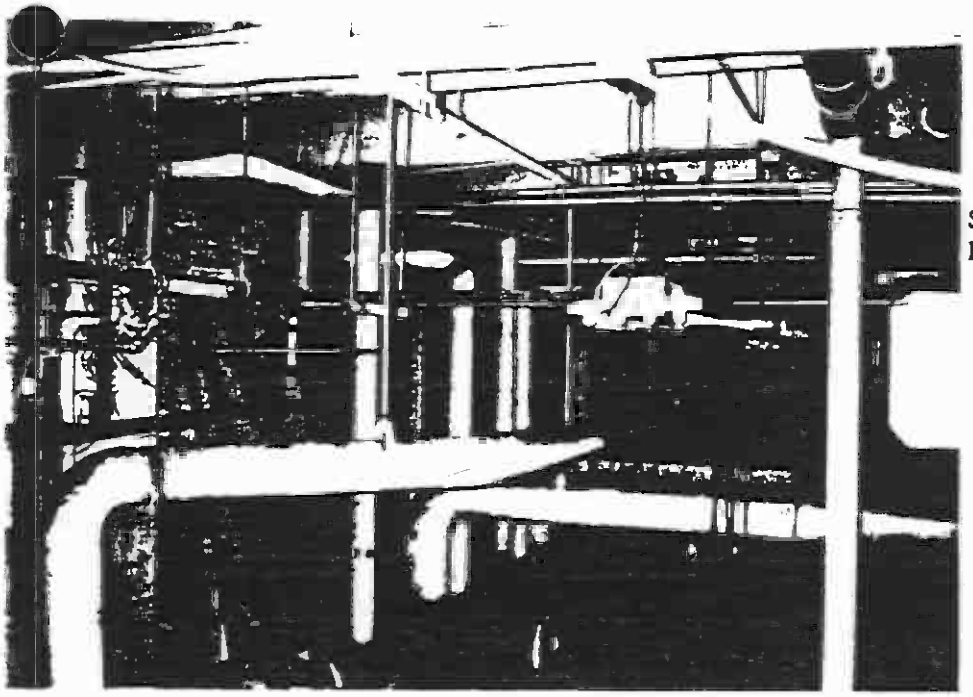
FIRST FLOOR PARKING STRUCTURE - MAIN STREAM HEADER UP FROM BOILER ROOM



PIPE ELBOW IN BOILER ROOM

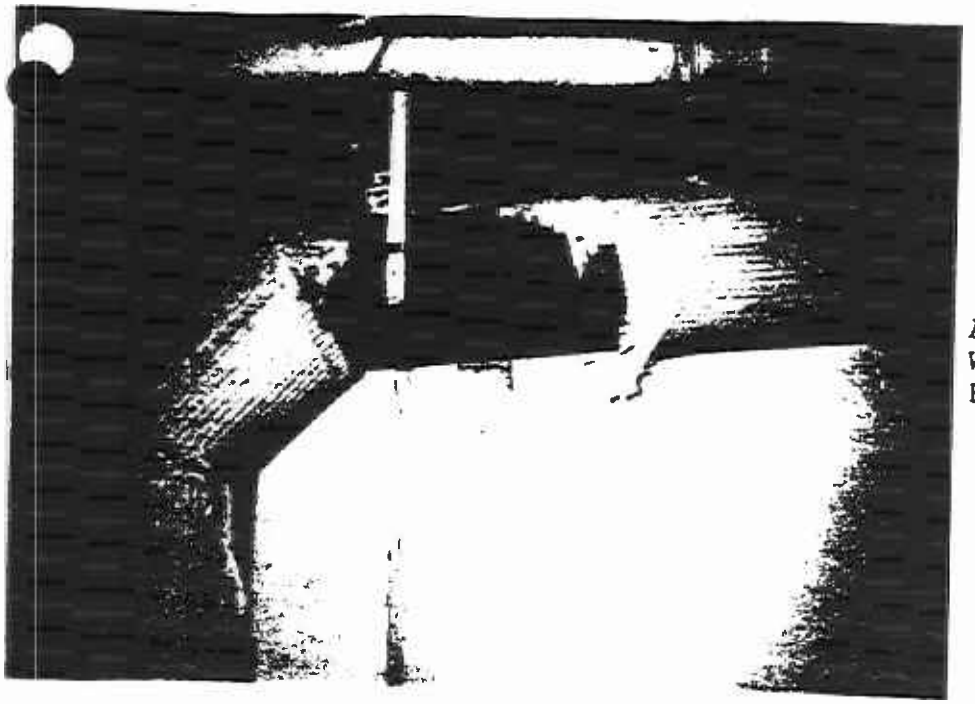


PIPING IN BOILER ROOM AT ABANDONED WATER TANK

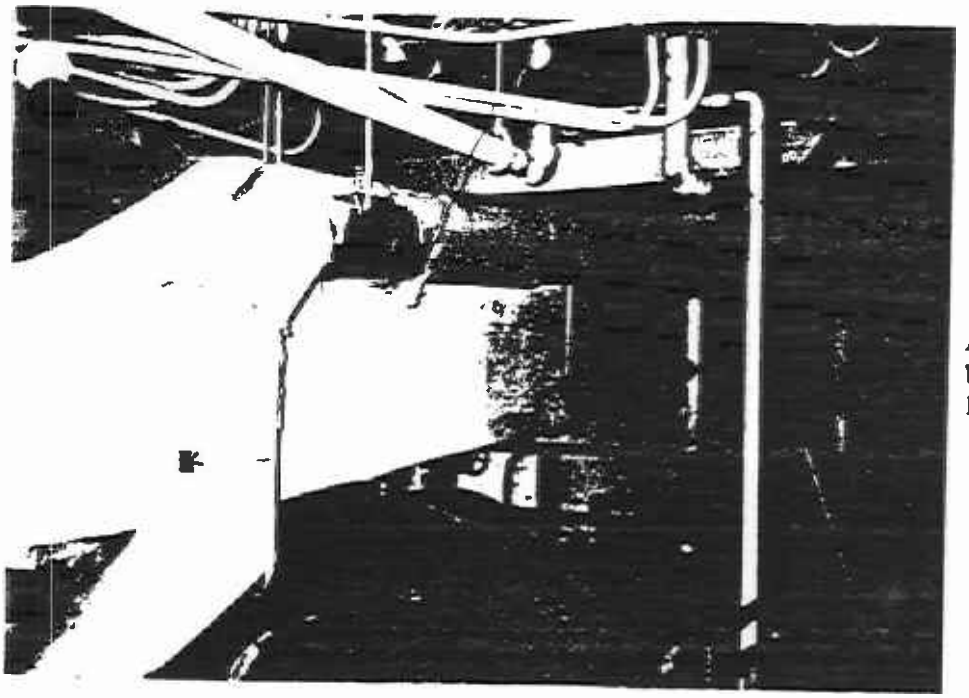


STEAM PIPING IN BOILER ROOM

R293/13
3105

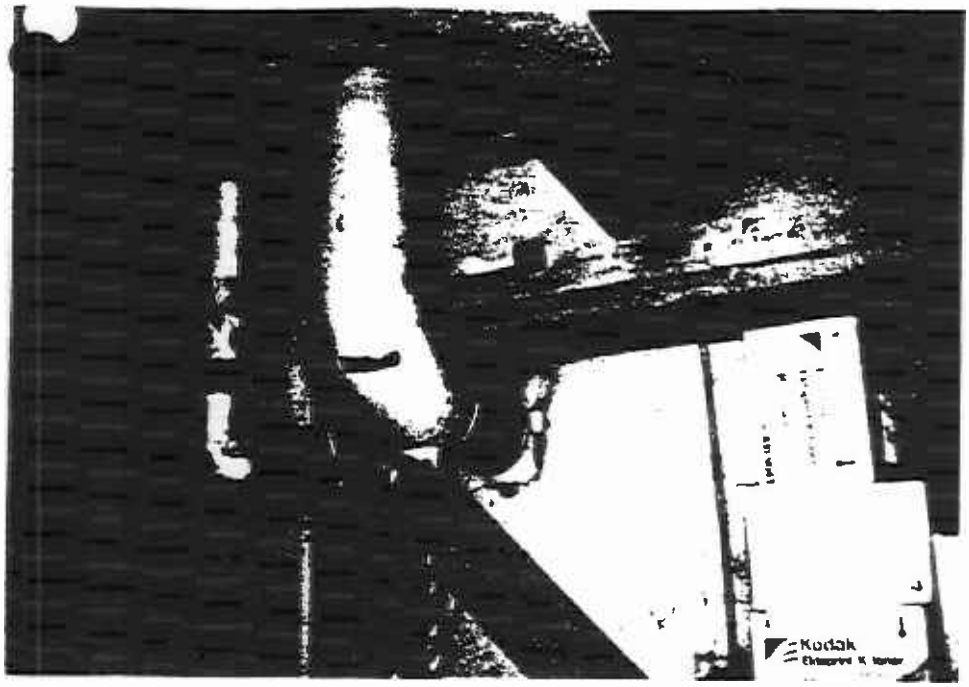


AIR CELL OFF HOT
WATER TANK EXHAUST
BOILER ROOM



AIR CELL OFF HOT
WATER TANK EXHAUST
BOILER ROOM

MED-TOX ASSOCIATES INC

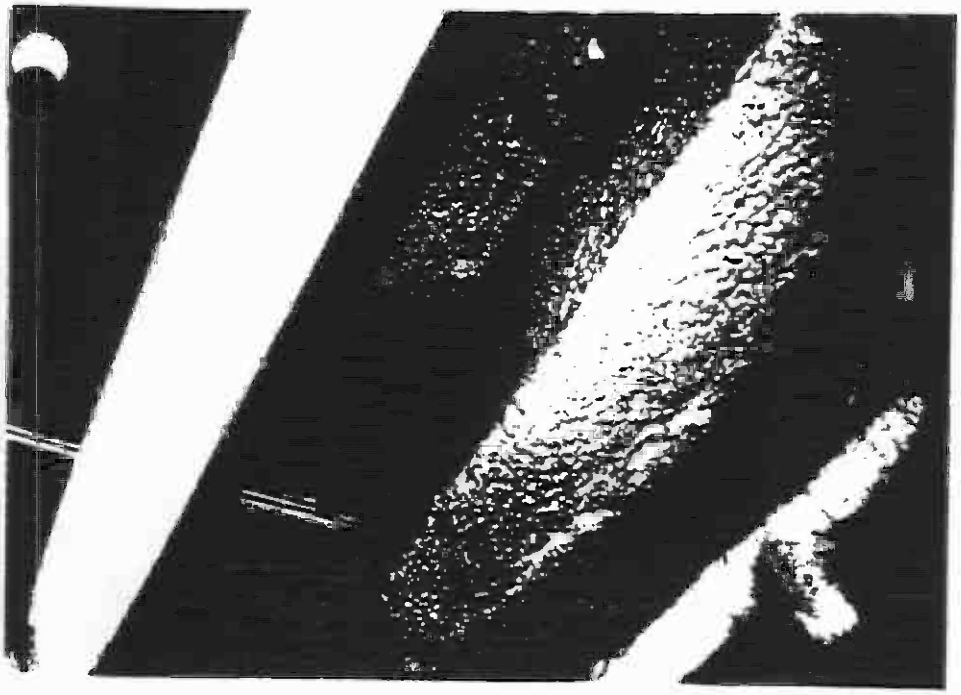


STEAM PIPING THROUGH
WALL IN RECEIVING AREA

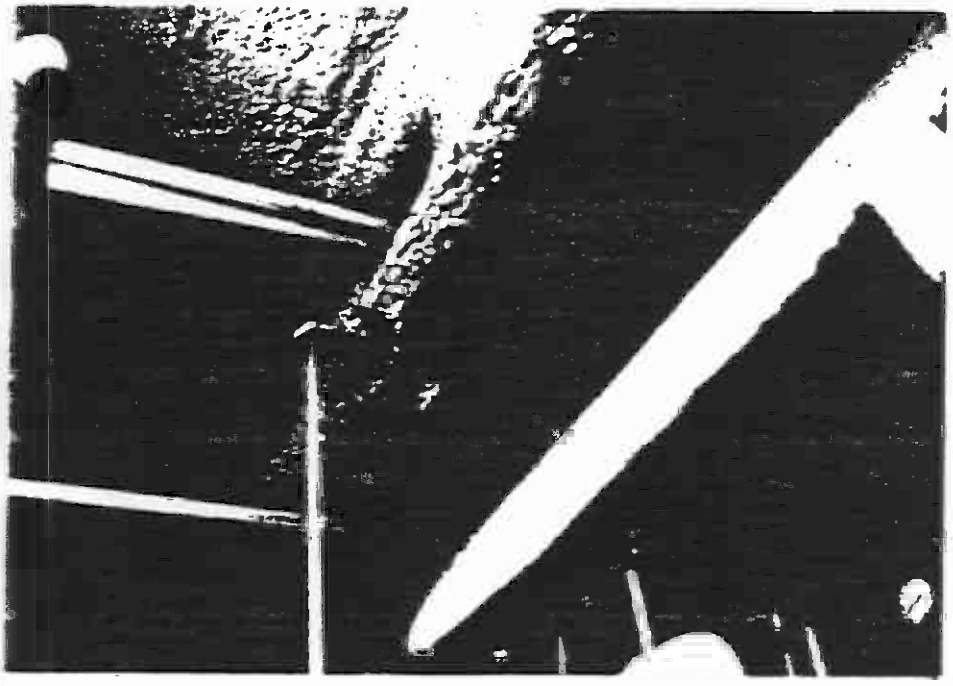
SAMPLES JLB0223-3
JLB0223-4
JLB0223-5

DEBRIS ON FLOOR OF
BOILER ROOM NEXT TO
HOT WATER TANK

80 PERCENT ASBESTOS

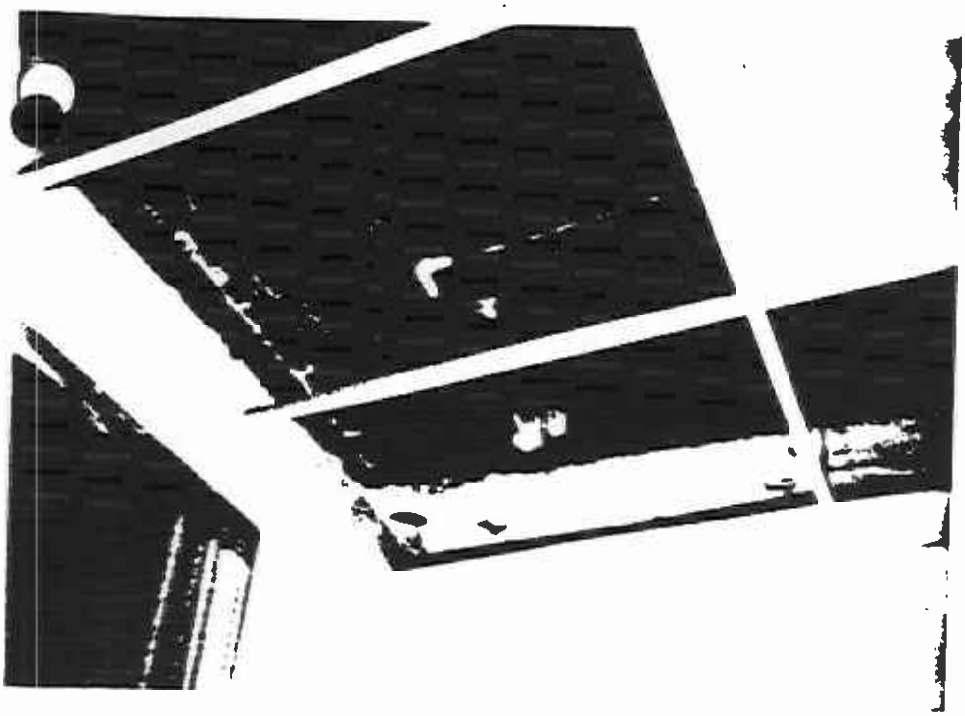


SPRAYED ON FIREPROOFING
(TYPICAL)

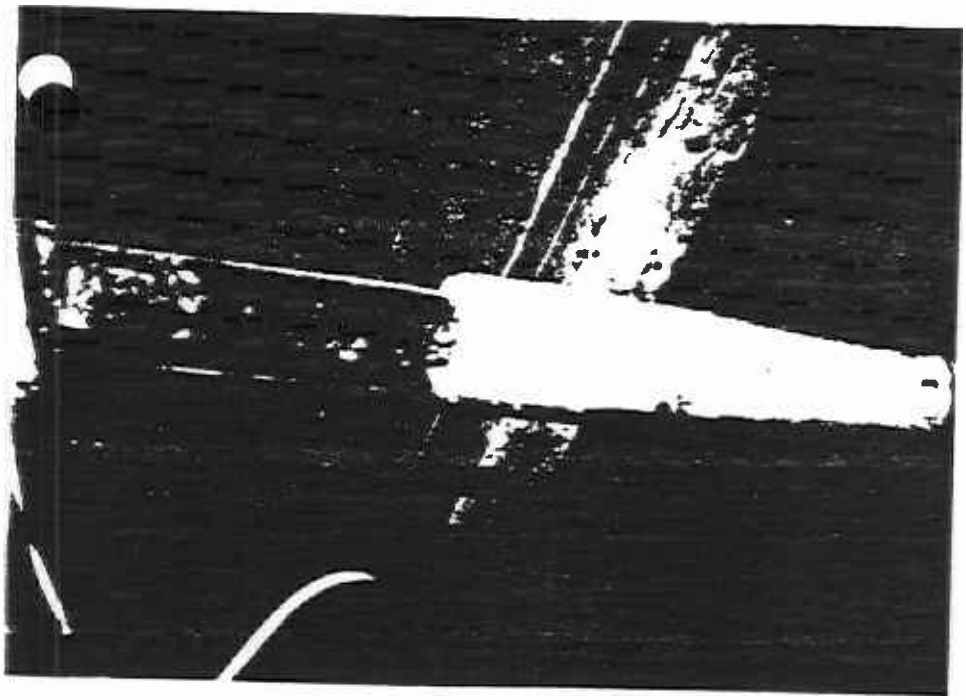


SPRAYED ON FIREPROOFING
(TYPICAL)

MED-TOX ASSOCIATES INC

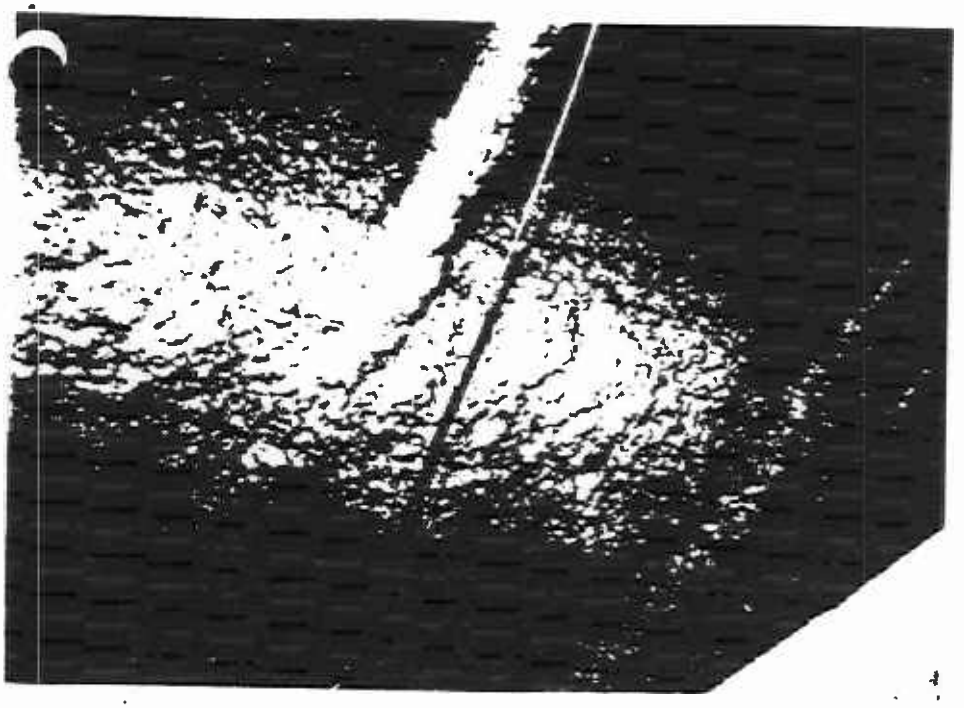


PARTIALLY ABATED PIPING ABOVE CEILING ON 4TH FLOOR OF ANNEX C

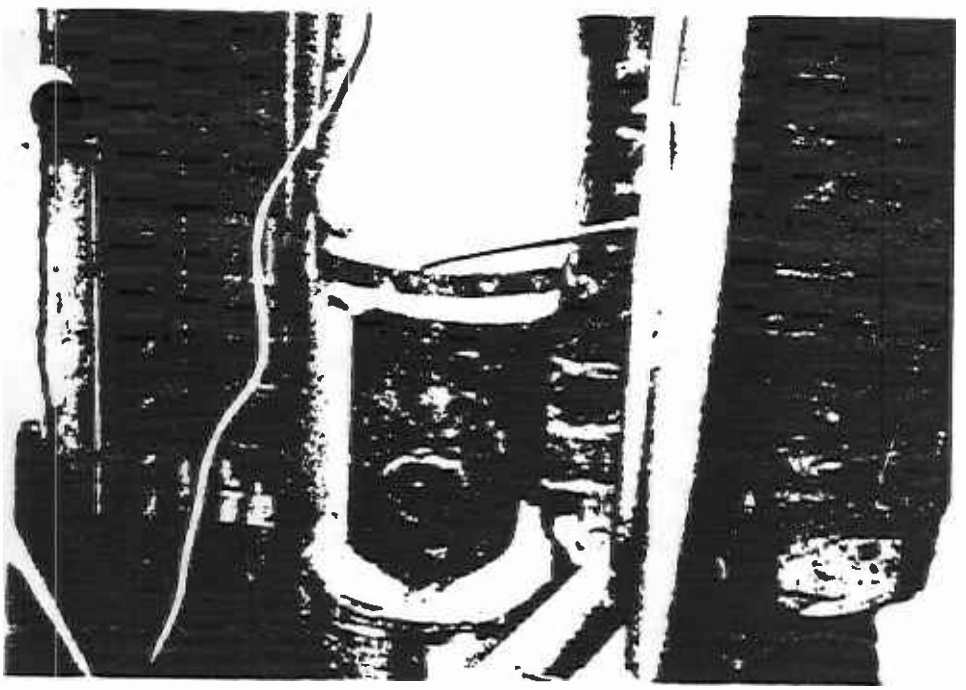


PARTIALLY ABATED PIPING ABOVE CEILING ON 4TH FLOOR OF ANNEX C

MED-TOX ASSOCIATES INC



NEW FIREPROOFING ON
FOURTH FLOOR BUILDING
ANNEX'S A, B, AND C



STEAM
PIPING ON 7TH FLOOR,
410 SPRING STREET

R293/13
3105

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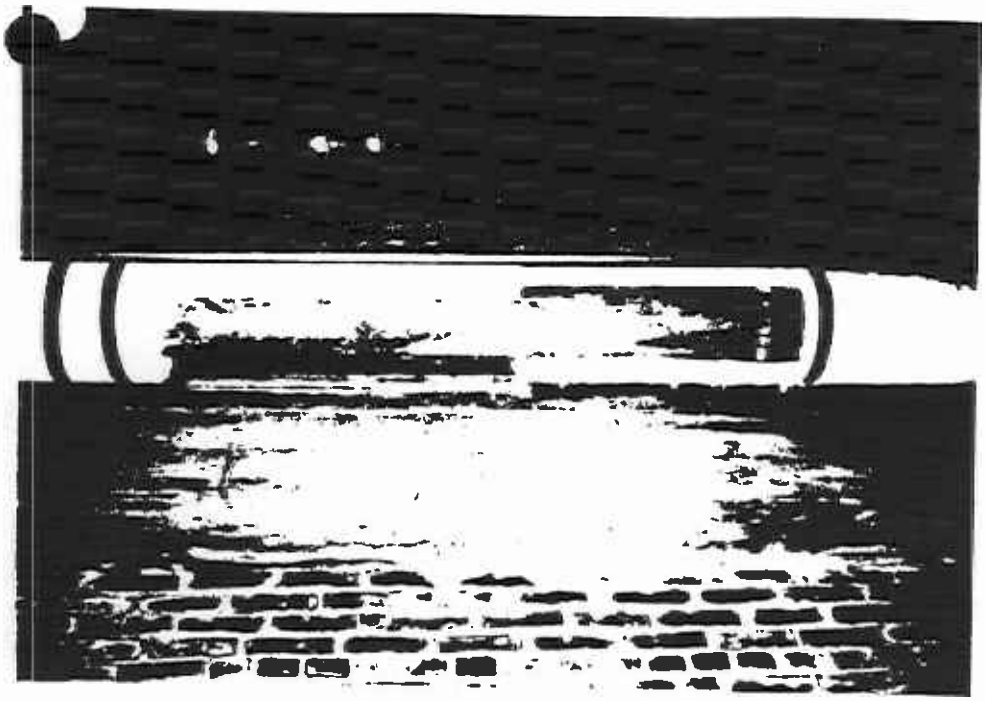
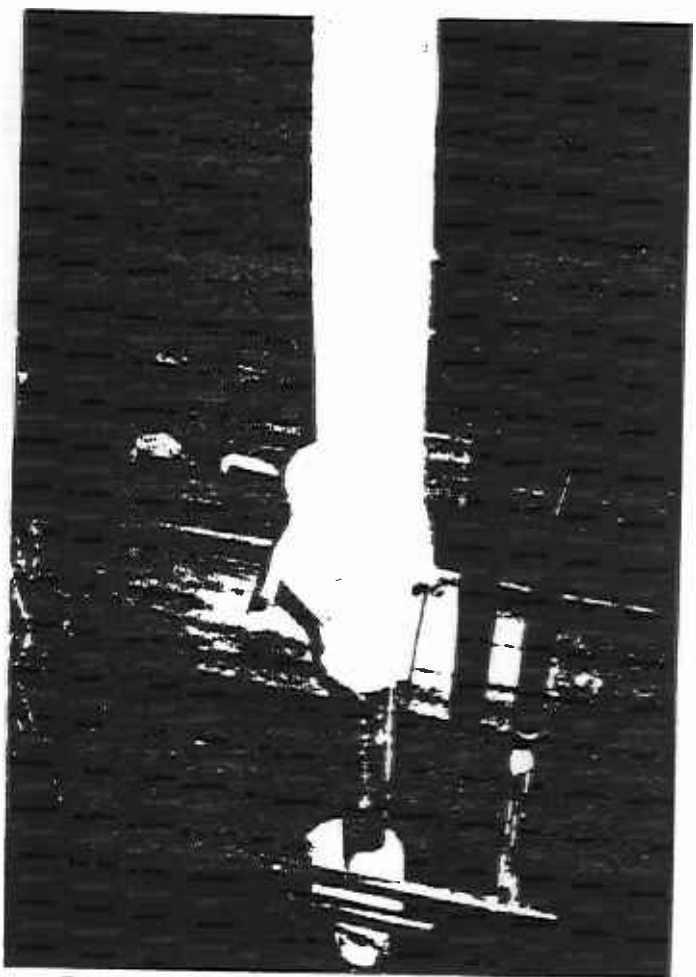


BUILDING 410
PIPING INSULATION
7th FLOOR



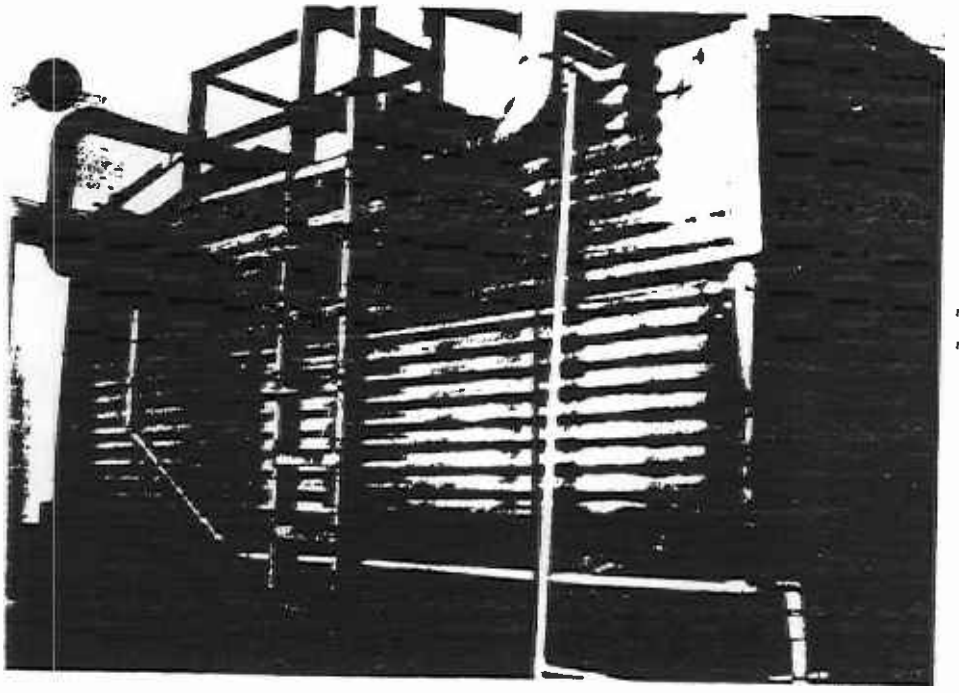
BUILDING 410
PIPING INSULATION
7th FLOOR

R293/13
3105

MED-TOX ASSOCIATES INC

ROOF PIPING

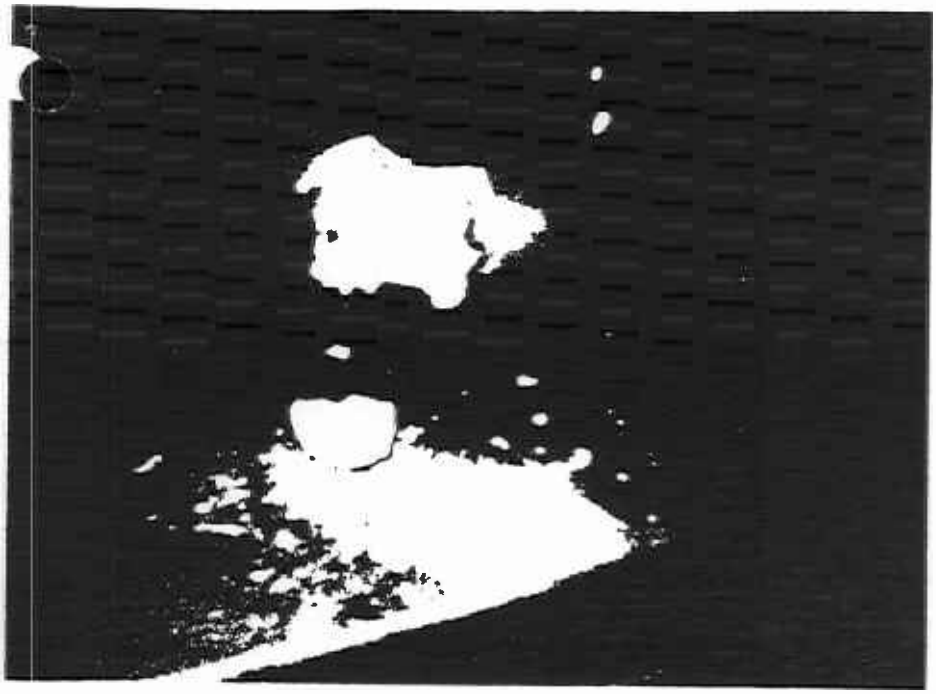
SAMPLE JLB0224-33
JLB0224-34



TRANSITE COOLING TOWER ON ROOF

R293/13
3105

MED-TOX ASSOCIATES INC



ROOF
CHILLER ROOM PIPE ELBOW

R293/13
3105

OSHA Asbestos Standard for General Industry, Maritime

## PART 1910—[AMENDED]

Part 1910 of Title 29 of the Code of Federal Regulations is hereby amended as follows:

1. The authority citation for Subpart B of Part 1910 continues to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act, 29 U.S.C. 653, 655, 657; Walsh-Healey Act, 41 U.S.C. 35 et seq.; Service Contract Act of 1965, 41 U.S.C. 351 et seq.; Pub. L. 91-54, 40 U.S.C. 333; Pub. L. 85-742, 33 U.S.C. 941; National Foundation on Arts and Humanities Act, 20 U.S.C. 951 et seq.; Secretary of Labor's Orders 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736); and 29 CFR Part 1911.

2. Paragraph (e) of § 1910.19 is hereby revised to read as follows:

**§ 1910.19 Special provisions for air contaminants.**

(e) *Asbestos, tremolite, anthophyllite, and actinolite dust.* Section 1910.1001 shall apply to the exposure of every employee to asbestos, tremolite, anthophyllite, and actinolite dust in every employment and place of employment covered by §§ 1910.13, 1910.14, 1910.15, or 1910.16, in lieu of any different standard on exposure to asbestos, tremolite, anthophyllite, and actinolite dust which would otherwise be applicable by virtue of any of those sections.

* * * * *

## Subpart Z—[Amended]

3. The authority citation for Subpart Z of Part 1910 is revised as follows:

Authority: Secs. 6 and 8, Occupational Safety and Health Act, 29 U.S.C. 655, 657; Secretary of Labor's Orders Nos. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable; and 29 CFR Part 1911.

Section 1910.1000 Tables Z-1, Z-2, Z-3 also issued under 5 U.S.C. 553.

Section 1910.1000 not issued under 29 CFR Part 1911, except for "Arsenic" and "Cotton Dust" listings in Table Z-1.

Section 1910.1002 not issued under 29 U.S.C. 655 or 29 CFR Part 1911; also issued under 5 U.S.C. 553.

Sections 1910.1003 through 1910.1018 also issued under 29 U.S.C. 653.

Section 1910.1025 also issued under 29 U.S.C. 653 and 5 U.S.C. 556.

Section 1910.1043 also issued under 5 U.S.C. 551 et seq.

Sections 1910.1045 and 1910.1047 also issued under 29 U.S.C. 653.

Sections 1910.1499 and 1910.1500 also issued under 5 U.S.C. 553.

4. Section 1910.1001 is hereby revised to read as follows:

**§ 1910.1001 Asbestos, tremolite, anthophyllite, and actinolite.**

(a) *Scope and application.* (1) This section applies to all occupational exposures to asbestos, tremolite, anthophyllite, and actinolite, in all industries covered by the Occupational Safety and Health Act, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to construction work as defined in 29 CFR 1910.12(b). [Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58.]

(b) *Definitions.* "Action level" means an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals, of 0.1 fiber per cubic centimeter (f/cc) of air calculated as an eight (8)—hour time-weighted average.

"Asbestos" includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Authorized person" means any person authorized by the employer and required by work duties to be present in regulated areas.

"Director" means the Director of the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Employee exposure" means that exposure to airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals that would occur if the employee were not using respiratory protective equipment.

"Fiber" means a particulate form of asbestos, tremolite, anthophyllite, or actinolite, 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

"High-efficiency particulate air (HEPA) filter" means a filter capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles.

"Regulated area" means an area established by the employer to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed, or can reasonably be expected to exceed, the permissible exposure limit.

"Tremolite, anthophyllite, or actinolite" means the non-asbestos form of these minerals, and any of these minerals that have been chemically treated and/or altered.

(c) *Permissible exposure limit (PEL).* The employer shall ensure that no employee is exposed to an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of 0.2 fiber per cubic centimeter of air as an eight (8)-hour time-weighted average (TWA) as determined by the method prescribed in Appendix A of this section, or by an equivalent method.

(d) *Exposure monitoring.*—(1) *General.* (i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA of each employee.

(ii) Representative 8-hour TWA employee exposures shall be determined on the basis of one or more samples representing full-shift exposures for each shift for each employee in each job classification in each work area.

(2) *Initial monitoring.* (i) Each employer who has a workplace or work operation covered by this standard, except as provided for in paragraphs (d)(2)(ii) and (d)(2)(iii) of this section, shall perform initial monitoring of employees who are, or may reasonably be expected to be exposed to airborne concentrations at or above the action level.

(ii) Where the employer has monitored after December 20, 1985, and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(2)(i) of this section.

(iii) Where the employer has relied upon objective data that demonstrates that asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is not capable of being released in airborne concentrations at or above the action level under the expected conditions of processing, use, or handling, then no initial monitoring is required.

(3) *Monitoring frequency (periodic monitoring) and patterns.* After the initial determinations required by

paragraph (d)(2)(i) of this section, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than six months for employees whose exposures may reasonably be foreseen to exceed the action level.

(4) *Changes in monitoring frequency.* If either the initial or the periodic monitoring required by paragraphs (d)(2) and (d)(3) of this section statistically indicates that employee exposures are below the action level, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(5) *Additional monitoring.* Notwithstanding the provisions of paragraphs (d)(2)(ii) and (d)(4) of this section, the employer shall institute the exposure monitoring required under paragraphs (d)(2)(i) and (d)(3) of this section whenever there has been a change in the production, process, control equipment, personnel or work practices that may result in new or additional exposures above the action level or when the employer has any reason to suspect that a change may result in new or additional exposures above the action level.

(6) *Method of monitoring.* (i) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be personal samples collected following the procedures specified in Appendix A.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be evaluated using the OSHA Reference Method (ORM) specified in Appendix A of this section, or an equivalent counting method.

(iii) If an equivalent method to the ORM is used, the employer shall ensure that the method meets the following criteria:

(A) Replicate exposure data used to establish equivalency are collected in side-by-side field and laboratory comparisons; and

(B) The comparison indicates that 90% of the samples collected in the range 0.5 to 2.0 times the permissible limit have an accuracy range of plus or minus 25 percent of the ORM results with a 95% confidence level as demonstrated by a statistically valid protocol; and

(C) The equivalent method is documented and the results of the comparison testing are maintained.

(iv) To satisfy the monitoring requirements of paragraph (d) of this section, employers must use the results of monitoring analysis performed by laboratories which have instituted quality assurance programs that include the elements as prescribed in Appendix A.

(7) *Employee notification of monitoring results.* (i) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under the standard, notify the affected employees of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) The written notification required by paragraph (d)(7)(i) of this section shall contain the corrective action being taken by the employer to reduce employee exposure to or below the PEL, wherever monitoring results indicated that the PEL had been exceeded.

(e) *Regulated Areas.*—(1) *Establishment.* The employer shall establish regulated areas wherever airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals are in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(2) *Demarcation.* Regulated areas shall be demarcated from the rest of the workplace in any manner that minimizes the number of persons who will be exposed to asbestos, tremolite, anthophyllite, or actinolite.

(3) *Access.* Access to regulated areas shall be limited to authorized persons or to persons authorized by the Act or regulations issued pursuant thereto.

(4) *Provision of respirators.* Each person entering a regulated area shall be supplied with and required to use a respirator, selected in accordance with paragraph (g)(2) of this section.

(5) *Prohibited activities.* The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated areas.

(f) *Methods of compliance.*—(1) *Engineering controls and work practices.* (i) The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to or below the exposure limit prescribed in paragraph (c) of this section, except to the extent that such controls are not feasible.

(ii) Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (g) of this section.

(iii) For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to or below 0.5 fiber per cubic centimeter of air (as an eight-hour time-weighted average) and shall supplement them by the use of any combination of respiratory protection that complies with the requirements of paragraph (g) of this section, work practices and feasible engineering controls that will reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section: Coupling cutoff in primary asbestos cement pipe manufacturing; sanding in primary and secondary asbestos cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.

(iv) Local exhaust ventilation. Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with good practices such as those found in the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2–1979.

(v) Particular tools. All hand-operated and power-operated tools which would produce or release fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems which comply with paragraph (f)(1)(iv) of this section.

(vi) Wet methods. Insofar as practicable, asbestos, tremolite, anthophyllite, or actinolite shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, unless the usefulness of the product would be diminished thereby.

(vii) Materials containing asbestos, tremolite, anthophyllite, or actinolite shall not be applied by spray methods.

(viii) Particular products and operations. No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos, tremolite, anthophyllite, or actinolite shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the limit prescribed in paragraph (c) of this section.

(ix) Compressed air. Compressed air shall not be used to remove asbestos, tremolite, anthophyllite, or actinolite or materials containing asbestos, tremolite, anthophyllite, or actinolite, unless the compressed air is used in conjunction with a ventilation system designed to capture the dust cloud created by the compressed air.

(2) *Compliance program.* (i) Where the PEL is exceeded, the employer shall establish and implement a written program to reduce employee exposure to or below the limit by means of engineering and work practice controls as required by paragraph (f)(1) of this section, and by the use of respiratory protection where required or permitted under this section.

(ii) Such programs shall be reviewed and updated as necessary to reflect significant changes in the status of the employer's compliance program.

(iii) Written programs shall be submitted upon request for examination and copying to the Assistant Secretary, the Director, affected employees and designated employee representatives.

(iv) The employer shall not use employee rotation as a means of compliance with the PEL.

(g) *Respiratory protection*—(1) *General.* The employer shall provide respirators, and ensure that they are used, where required by this section. Respirators shall be used in the following circumstances:

(i) During the interval necessary to install or implement feasible engineering and work practice controls;

(ii) In work operations, such as maintenance and repair activities, or other activities for which engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the exposure limit; and

(iv) In emergencies.

(2) *Respirator selection.* (i) Where respirators are required under this section, the employer shall select and provide, at no cost to the employee, the appropriate respirator as specified in Table 1. The employer shall select respirators from among those jointly approved as being acceptable for protection by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(ii) The employer shall provide a powered, air-purifying respirator in lieu of any negative pressure respirator specified in Table 1 whenever:

(A) An employee chooses to use this type of respirator; and

(B) This respirator will provide adequate protection to the employee.

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS, TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE FIBERS

| Airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals | Required respirator |
|---|---|
| Not in excess of 2 f/cc (10 X PEL). | 1. Half-mask air-purifying respirator equipped with high-efficiency filters. |
| Not in excess of 10 f/cc (50 X PEL). | 1. Full facepiece air-purifying respirator equipped with high-efficiency filters.<br>1. Any powered air-purifying respirator equipped with high-efficiency filters.<br>2. Any supplied-air respirator operated in continuous flow mode. |
| Not in excess of 20 f/cc (100 X PEL). | 1. Full facepiece supplied-air respirator operated in pressure demand mode. |
| Not in excess of 200 f/cc (1000 X PEL). | 1. Full facepiece supplied-air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus. |
| Greater than 200 f/cc (> 1,000 X PEL) or unknown concentration. | |

NOTE: a. Respirators assigned for higher environmental concentrations may be used at lower concentrations.
b. A high-efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.

(3) *Respirator program.* (i) Where respiratory protection is required, the employer shall institute a respirator program in accordance with 29 CFR 1910.134(b), (d), (e), and (f).

(ii) The employer shall permit each employee who uses a filter respirator to change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of filter elements for this purpose.

(iii) Employees who wear respirators shall be permitted to leave the regulated area to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.

(iv) No employee shall be assigned to tasks requiring the use of respirators if, based upon his or her most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or other employees will be impaired by the use of a respirator. Such employee shall be assigned to another job or given the opportunity to transfer to a different position whose duties he or she is able to perform with the same employer, in the same geographical area and with the same seniority, status, and rate of pay the employee had just prior to such transfer, if such a different position is available.

(4) *Respirator fit testing.* (i) The employer shall ensure that the respirator issued to the employee exhibits the least possible facepiece leakage and that the respirator is fitted properly.

(ii) For each employee wearing negative pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every six months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, and shall be conducted in accordance with Appendix C. The tests shall be used to select facepieces that provide the required protection as prescribed in Table 1.

(h) *Protective work clothing and equipment*—(1) *Provision and use.* If an employee is exposed to asbestos, tremolite, anthophyllite, actunolite, or a combination of these minerals above the PEL, or where the possibility of eye irritation exists, the employer shall provide at no cost to the employee and ensure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, head coverings, and foot coverings; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with § 1910.133 of this Part.

(2) *Removal and storage.* (i) The employer shall ensure that employees remove work clothing contaminated with asbestos, tremolite, anthophyllite, or actinolite only in change rooms provided in accordance with paragraph (i)(1) of this section.

(ii) The employer shall ensure that no employee takes contaminated work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(iii) Contaminated work clothing shall be placed and stored in closed containers which prevent dispersion of the asbestos, tremolite, anthophyllite, and actinolite outside the container.

(iv) Containers of contaminated protective devices or work clothing which are to be taken out of change rooms or the workplace for cleaning, maintenance or disposal, shall bear labels in accordance with paragraph (j)(2) of this section.

(3) *Cleaning and replacement.* (i) The employer shall clean, launder, repair, or replace protective clothing and equipment required by this paragraph to maintain their effectiveness. The employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall prohibit the removal of asbestos, tremolite, anthophyllite, and actinolite from protective clothing and equipment by blowing or shaking.

(iii) Laundering of contaminated clothing shall be done so as to prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(iv) Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in paragraph (h)(3)(iii) of this section to effectively prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit.

(v) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with asbestos, tremolite, anthophyllite, or actinolite, of the potentially harmful effects of exposure to asbestos, tremolite, anthophyllite, or actinolite.

(vi) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled in accordance with paragraph (j) of this seciton.

(i) *Hygiene facilities and practices.*—(1) *Change rooms.* (i) The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is above the permissible exposure limit.

(ii) The employer shall ensure that change rooms are in accordance with § 1910.141(e) of this part, and are equipped with two separate lockers or storage facilities, so separated as to prevent contamination of the employee's street clothes from his protective work clothing and equipment.

(2) *Showers.* (i) The employer shall ensure that employees who work in areas where their airborne exposure is above the permissible exposure limit shower at the end of the work shift.

(ii) The employer shall provide shower facilities which comply with § 1910.141(d)(3) of this part.

(iii) The employer shall ensure that employees who are required to shower pursuant to paragraph (i)(2)(i) of this section do not leave the workplace wearing any clothing or equipment worn during the work shift.

(3) *Lunchrooms.* (i) The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure is above the permissible exposure limit.

(ii) The employer shall ensure that lunchroom facilities have a positive pressure, filtered air supply, and are readily accessible to employees.

(iii) The employer shall ensure that employees who work in areas where their airborne exposure is above the permissible exposure limit wash their hands and faces prior to eating, drinking or smoking.

(iv) The employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface asbestos, tremolite, anthophyllite, and actinolite fibers have been removed from the clothing or equipment by vaccuming or other method that removes dust without causing the asbestos, tremolite, anthophyllite, or actinolite to become airborne.

(j) *Communication of hazards to employees.*—(1) *Warning signs.* (i) Posting. Warning signs shall be provided and displayed at each regulated area. In addition, warning signs shall be posted at all approaches to regulated areas so that an employee may read the signs and take necessary protective steps before entering the area.

(ii) Sign specifications. The warning signs required by paragraph (j)(1)(i) of this section shall bear the following information:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE
HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE
CLOTHING
ARE REQUIRED IN THIS AREA

(iii) Where minerals in the regulated area are only tremolite, anthophyllite or actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(2) *Warning labels.* (i) Labeling. Warning labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos, tremolite, anthophyllite, or actinolite fibers, or to their containers.

(ii) Label specifications. The labels shall comply with the requirements of 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard, and shall include the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE
HAZARD

(iii) Where minerals to be labeled are only tremolite, anthophyllite, or actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(3) *Material safety data sheets.* Employers who are manufacturers or importers of asbestos, tremolite, anthophyllite, or actinolite or asbestos, tremolite, anthophyllite, or actionlite products shall comply with the requirements regarding development of material safety data sheets as specified in 29 CFR 1910.1200(g) of OSHA's Hazard Communication standard, except as provided by paragraph (j)(4) of this section.

(4) The provisions for labels required by paragraph (j)(2) or for material safety data sheets required by paragraph (j)(3) do not apply where:

(i) Asbestos, tremolite, anthophyllite, or actinolite fibers have been modified by a bonding agent, coating, binder, or other material provided that the manufacturer can demonstrate that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the action level will be released or

(ii) Asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is present in a product in concentrations less than 0.1%.

(5) *Employee information and training.* (i) The employer shall institute a training program for all employees who are exposed to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level ensure their participation in the program.

(ii) Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

(iii) The training program shall be conducted in a manner which the employee is able to understand. The employer shall ensure that each employee is informed of the following:

(A) The health effect associated with asbestos, tremolite, anthophyllite, or actinolite exposure;

(B) The relationship between smoking and exposure to asbestos, tremolite, anthophyllite, and actinolite in producing lung cancer;

(C) The quantity, location, manner of use, release, and storage of asbestos, tremolite, anthophyllite, or actinolite, and the specific nature of operations which could result in exposure to asbestos, tremolite, anthophyllite,or actinolite;

(D) The engineering controls and work practices associated with the employee's job assignment;

(E) The specific procedures implemented to protect employees from exposure to asbestos, tremolite, anthophyllite, or actinolite, such as appropriate work practices, emergency and clean-up procedures, and personal protective equipment to be used;

(F) The purpose, proper use, and limitations of respirators and protective clothing;

(G) The purpose and a description of the medical surveillance program required by paragraph (l) of this section;

(H) A review of this standard, including appendices.

(iv) Access to information and training materials.

(A) The employer shall make a copy of this standard and its appendices readily available without cost to all affected employees.

(B) The employer shall provide, upon request, all materials relating to the employee information and training program to the Assistant Secretary and the training program to the Assistant Secretary and the Director.

(k) *Housekeeping.* (1) All surfaces shall be maintained as free as practicable of accumulations of dusts and waste containing asbestos, tremolite, anthophyllite, or actinolite.

(2) All spills and sudden releases of material containing asbestos, tremolite, anthophyllite, or actinolite shall be cleaned up as soon as possible.

(3) Surfaces contaminated with asbestos, tremolite, anthophyllite, or actinolite may not be cleaned by the use of compressed air.

(4) Vacuuming. HEPA-filtered vacuuming equipment shall be used for vacuuming. The equipment shall be used and emptied in a manner which minimizes the reentry of asbestos, tremolite, anthophyllite, or actinolite into the workplace.

(5) Shoveling, dry sweeping and dry clean-up of asbestos, tremolite, anthophyllite, or actinolite may be used only where vacuuming and/or wet cleaning are not feasible.

(6) Waste disposal. Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with asbestos, tremolite, anthophyllite, or actinolite consigned for disposal, shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(l) *Medical surveillance*—(1) *General.*—(i) *Employees covered.* The employer shall institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(ii) *Examination by a physician.* (A) The employer shall ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee and at a reasonable time and place.

(B) Persons other than licensed physicians, who administer the pulmonary function testing required by this section, shall complete a training course in spirometry sponsored by an appropriate academic or professional institution.

(2) *Preplacement examinations.* (i) Before an employee is assigned to an occupation exposed to airborne concentrations of asbestos, tremolite, anthophyllite, or actinolite fibers, a preplacement medical examination shall be provided or made available by the employer.

(ii) Such examination shall include, as a minimum, a medical and work history; A complete physical examination of all systems with emphasis on the respiratory system, the cardiovascular system and digestive tract; completion of the respiratory disease standardized questionnaire in Appendix D, Part 1; a chest roentgenogram (posterior-anterior 14x17 inches); pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$); and any additional tests deemed appropriate by the examining physician. Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E.

(3) *Periodic examinations.* (i) Periodic medical examinations shall be made available annually.

(ii) The scope of the medical examination shall be in conformance with the protocol established in paragraph (l)(2)(ii), except that the frequency of chest roentgenograms shall be conducted in accordance with Table 2, and the abbreviated standardized questionnaire contained in Appendix D, Part 2, shall be administered to the employee.

TABLE 2.—FREQUENCY OF CHEST ROENTGENOGRAMS

| Years since first exposure | Age of employee | | |
|---|---|---|---|
| | 15 to 35 | 35+ to 45 | 45+ |
| 0 to 10 | Every 5 years | Every 5 years | Every 5 years. |
| 10+ | Every 5 years | Every 2 years | Every 1 year. |

(4) *Termination of employment examinations.* (i) The employer shall provide, or make available, a termination of employment medical examination for any employee who has been exposed to airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(ii) The medical examination shall be in accordance with the requirements of the periodic examinations stipulated in paragraph (l)(3) of this section, and shall be given within 30 calendar days before or after the date of termination of employment.

(5) *Recent examinations.* No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with any of the preceding paragraphs [(l)(2)–(l)(4)] within the past 1 year period.

(6) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this standard and Appendices D and E.

(ii) A description of the affected employee's duties as they relate to the employee's exposure.

(iii) The employee's representative exposure level or anticipated exposure level.

(iv) A description of any personal protective and respiratory equipment used or to be used.

(v) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

(7) *Physician's written opinion.* (i) The employer shall obtain a written signed opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

(A) The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, tremolite, anthophyllite, or actinolite;

(B) Any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators; and

(C) A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions resulting from asbestos, tremolite, anthophyllite, or actinolite exposure that require further explanation or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos, tremolite, anthophyllite, or actinolite.

(iii) The employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.

(m) *Recordkeeping.*—(1) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos, tremolite, anthophyllite, or actinolite as prescribed in paragraph (d) of this section.

(ii) This record shall include at least the following information:

(A) The date of measurement;

(B) The operation involving exposure to asbestos, tremolite, anthophyllite, or actinolite which is being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of respiratory protective devices worn, if any; and

(F) Name, social security number and exposure of the employees whose exposure are represented.

(iii) The employer shall maintain this record for at least thirty (30) years, in accordance with 29 CFR 1910.20.

(2) *Objective data for exempted operations.* (i) Where the processing, use, or handling of products made from or containing asbestos, tremolite, anthophyllite, or actinolite is exempted from other requirements of this section under paragraph (d)(2)(iii) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) The record shall include at least the following:

(A) The product qualifying for exemption;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of asbestos, tremolite, anthophyllite, or actinolite;

(D) A description of the operation exempted and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

Note.—The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (l)(1)(i) of this section, in accordance with 29 CFR 1910.20.

(ii) The record shall include at least the following information:

(A) The name and social security number of the employee;

(B) Physician's written opinions;

(C) Any employee medical complaints related to exposure to asbestos, tremolite, anthophyllite, or actinolite; and

(D) A copy of the information provided to the physician as required by paragraph (l)(6) of this section.

(iii) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with 29 CFR 1910.20.

(4) *Training.* The employer shall maintain all employee training records for one (1) year beyond the last date of employment of that employee.

(5) *Availability.* (i) The employer, upon written request, shall make all records required to be maintained by this section available to the Assistant Secretary and the Director for examination and copying.

(ii) The employer, upon request shall make any exposure records required by paragraph (m)(1) of this section available for examination and copying to affected employees, former employees, designated representatives and the Assistant Secretary, in accordance with 29 CFR 1910.20 (a)–(e) and (g)–(i).

(iii) The employer, upon request, shall make employee medical records required by paragraph (m)(2) of this section available for examination and copying to the subject employee, to anyone having the specific written consent of the subject employee, and the Assistant Secretary, in accordance with 29 CFR 1910.20.

(6) *Transfer of records.* (i) The employer shall comply with the requirements concerning transfer of records set forth in 29 CFR 1910.20(h).

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the Director at least 90 days prior to disposal of records and, upon request, transmit them to the Director.

(n) *Observation of monitoring.*—(1) *Employee observation.* The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite conducted in accordance with paragraph (d) of this section.

(2) *Observation procedures.* When observation of the monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite requires entry into an area where the use of protective clothing or equipment is required, the observer shall be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

(o) *Dates.*—(1) *Effective date.* This standard shall become effective July 21, 1986. The requirements of the asbestos standard issued in June 1972 (37 FR 11318), as amended, and published in 29 CFR 1910.1001 (1985) remain in effect until compliance is achieved with the parallel provisions of this standard.

(2) *Start-up dates.* All obligations of this standard commence on the effective date except as follows:

(i) *Exposure monitoring.* Initial monitoring required by paragraph (d)(2) of this section shall be completed as soon as possible but no later than October 20, 1986.

(ii) *Regulated areas.* Regulated areas required to be established by paragraph (e) of this section as a result of initial monitoring shall be set up as soon as possible after the results of that monitoring are known and not later than November 17, 1986.

(iii) *Respiratory protection.* Respiratory protection required by paragraph (g) of this section shall be

provided as soon as possible but no later than the following schedule:

(A) Employees whose 8-hour TWA exposure exceeds 2 fibers/cc—July 21, 1986.

(B) Employees whose 8-hour TWA exposure exceeds the PEL but is less than 2 fibers/cc—November 17, 1986.

(C) Powered air-purifying respirators provided under paragraph (g)(2)(ii)—January 16, 1987.

(iv) *Hygiene and lunchroom facilities.* Construction plans for changerooms, showers, lavatories, and lunchroom facilities shall be completed no later than January 16, 1987; and these facilities shall be constructed and in use no later than July 20, 1987. However, if as part of the compliance plan it is predicted by an independent engineering firm that engineering controls and work practices will reduce exposures below the permissible exposure limit by July 20, 1988, for affected employees, then such facilities need not be completed until 1 year after the engineering controls are completed, if such controls have not in fact succeeded in reducing exposure to below the permissible exposure limit.

(v) *Employee information and training.* Employee information and training required by paragraph (j)(5) of this section shall be provided as soon as possible but no later than October 20, 1986.

(vi) *Medical surveillance.* Medical examinations required by paragraph (1) of this section shall be provided as soon as possible but no later than November 17, 1986.

(vii) *Compliance program.* Written compliance programs required by paragraph (f)(2) of this section as a result of initial monitoring shall be completed and available for inspection and copying as soon as possible but no later than July 20, 1987.

(viii) *Methods of compliance.* The engineering and work practice controls as required by paragraph (f)(1) shall be implemented as soon as possible but no later than July 20, 1988.

(n) *Appendices.* (1) Appendices A, C, D, and E to this section are incorporated as part of this section and the contents of these Appendices are mandatory.

(2) Appendices B, F, G and H to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

## Appendix A to § 1910.1001—Osha Reference Method—Mandatory

This mandatory appendix specifies the procedure for analyzing air samples for asbestos, tremolite, anthophyllite, and actinolite and specifies quality control procedures that must be implemented by laboratories performing the analysis. The sampling and analytical methods described below represent the elements of the available monitoring methods (such as the NIOSH 7400 method) which OSHA considers to be essential to achieve adequate employee exposure monitoring while allowing employers to use methods that are already established within their organizations. All employers who are required to conduct air monitoring under paragraph (f) of the standard are required to utilize analytical laboratories that use this procedure, or an equivalent method, for collecting and analyzing samples.

### *Sampling and Analytical Procedure*

1. The sampling medium for air samples shall be mixed cellulose ester filter membranes. These shall be designated by the manufacturer as suitable for asbestos, tremolite, anthophyllite, and actinolite counting. See below for rejection of blanks.

2. The preferred collection device shall be the 25-mm diameter cassette with an open-faced 50-mm extension cowl. The 37-mm cassette may be used if necessary but only if written justification for the need to use the 37-mm filter cassette accompanies the sample results in the employee's exposure monitoring record.

3. An air flow rate between 0.5 liter/min and 2.5 liters/min shall be selected for the 25-mm cassette. If the 37-mm cassette is used, an air flow rate between 1 liter/min and 2.5 liters/min shall be selected.

4. Where possible, a sufficient air volume for each air sample shall be collected to yield between 100 and 1,300 fibers per square millimeter on the membrane filter. If a filter darkens in appearance or if loose dust is seen on the filter, a second sample shall be started.

5. Ship the samples in a rigid container with sufficient packing material to prevent dislodging the collected fibers. Packing material that has a high electrostatic charge on its surface (e.g., expanded polystyrene) cannot be used because such material can cause loss of fibers to the sides of the cassette.

6. Calibrate each personal sampling pump before and after use with a representative filter cassette installed between the pump and the calibration devices.

7. Personal samples shall be taken in the "breathing zone" of the employee (i.e., attached to or near the collar or lapel near the worker's face).

8. Fiber counts shall be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.

9. The microscope shall be fitted with a Walton-Beckett eyepiece graticule calibrated for a field diameter of 100 micrometers (+/−2 micrometers).

10. The phase-shift detection limit of the microscope shall be about 3 degrees measured using the HSE phase shift test slide as outlined below.

a. Place the test slide on the microscope stage and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

Note.—The slide consists of seven sets of grooved lines (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7, seven being the least visible. The requirements for asbestos, tremolite, anthophyllite, and actinolite counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 and 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.

11. Each set of samples taken will include 10 percent blanks or a minimum of 2 blanks. The blank results shall be averaged and subtracted from the analytical results before reporting. Any samples represented by a blank having a fiber count in excess of 7 fibers/100 fields shall be rejected.

12. The samples shall be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.

13. Observe the following counting rules.

a. Count only fibers equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.

b. Count all particles as asbestos, tremolite, anthophyllite, and actinolite that have a length-to-width ratio (aspect ratio) of 3:1 or greater.

c. Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle, shall receive the count of one half (½). Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.

14. Blind recounts shall be conducted at the rate of 10 percent.

### *Quality Control Procedures*

1. Intralaboratory program. Each laboratory and/or each company with more than one microscopist counting slides shall establish a statistically designed quality assurance program involving blind recounts and comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In a company with more than one laboratory, the program shall include all laboratories and shall also evaluate the laboratory-to-laboratory variability.

2. Interlaboratory program. Each laboratory analyzing asbestos, tremolite, anthophyllite, and actinolite samples for compliance determination shall implement an interlaboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory shall participate in round robin testing at least once every 6 months with at least all the other laboratories in its interlaboratory quality assurance group. Each laboratory shall submit slides typical of its own work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

3. All individuals performing asbestos, tremolite, anthophyllite, and actinolite analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos, tremolite, anthophyllite, and actinolite dust or an equallvalent course.

4. When the use of different microscopes contributes to differences between counters and laboratories, the effect of the different microscope shall be evaluated and the microscope shall be replaced, as necessary.

5. Current results of these quality assurance programs shall be posted in each laboratory to keep the microscopists informed.

**Appendix B to § 1910.1001—Detailed Procedure for Asbestos Tremolite, Anthophyllite, and Actinolite Sampling and Analysis—Non-Mandatory**

This appendix contains a detailed procedure for sampling and analysis and includes those critical elements specified in Appendix A. Employers are not required to use this procedure, but they are required to use Appendix A. The purpose of Appendix B is to provide a detailed step-by-step sampling and analysis procedure that conforms to the elements specified in Appendix A. Since this procedure may also standardize the analysis and reduce variability, OSHA encourages employers to use this appendix.

*Asbestos, Tremolite, Anthophyllite, and Actinolite Sampling and Analysis Method*

Technique: Microscopy, Phase Contrast
Analyte: Fibers (manual count)
Sample Preparation: Acetone/triacetin method
Calibration: Phase-shift detection limit about 3 degrees
Range: 100 to 1300 fibers/mm ² filter area
Estimated limit of detection: 7 fibers/mm ² filter area
Sampler: Filter (0.8–1.2 um mixed cellulose ester membrane, 25-mm diameter)
Flow rate: 0.5 l/min to 2.5 l/min (25-mm cassette) 1.0 l/min to 2.5 l/min (37-mm cassette)
Sample volume: Adjust to obtain 100 to 1300 fibers/mm ²
Shipment: Routine
Sample stability: Indefinite
Blanks: 10% of samples (minimum 2)
Standard analytical error: 0.25.

Applicability: The working range is 0.02 f/cc (1920–L air sample) to 1.25 f/cc (400–L air sample). The method gives an index of airborne asbestos, tremolite, anthophyllite, and actinolite fibers but may be used for other materials such as fibrous glass by inserting suitable parameters into the counting rules. The method does not differentiate between asbestos, tremolite, anthophyllite, and actinolite and other fibers. Asbestos, tremolite, anthophyllite, and actinolite fibers less than ca. 0.25 um diameter will not be detected by this method.

Interferences: Any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chainlike particles may appear fibrous. High levels of nonfibrous dust particles may obscure fibers in the field of view and raise the detection limit.

Reagents: 1. Acetone. 2. Triacetin (glycerol triacetate), reagent grade

Special precautions: Acetone is an extremely flammable liquid and precautions must be taken not to ignite it. Heating of acetone must be done in a ventilated laboratory fume hood using a flameless, spark-free heat source.

Equipment: 1. Collection device: 25-mm cassette with 50-mm extension cowl with cellulose ester filter, 0.8 to 1.2 mm pore size and backup pad.

Note: Analyze representative filters for fiber background before use and discard the filter lot if more than 5 fibers/100 fields are found.

2. Personal sampling pump, greater than or equal to 0.5-L/min, with flexible connecting tubing.

3. Microscope, phase contrast, with green or blue filter, 8 to 10X eyepiece, and 40 to 45X phase objective (total magnification ca 400X; numerical aperture = 0.65 to 0.75).

4. Slides, glass, single-frosted, pre-cleaned, 25 x 75 mm.

5. Cover slips, 25 x 25 mm, no. 1½ unless otherwise specified by microscope manufacturer.

6. Knife, No. 1 surgical steel, curved blade.

7. Tweezers.

8. Flask, Guth-type, insulated neck, 250 to 500 mL (with single-holed rubber stopper and elbow-jointed glass tubing, 18 to 22 cm long).

9. Hotplate, spark-free, stirring type; heating mantle; or infrared lamp and magnetic stirrer.

10. Syringe, hypodermic, with 22-gauge needle.

11. Graticule, Walton-Beckett type with 100 um diameter circular field at the specimen plane (area = 0.00785 mm ²). (Type C–22).

Note.—the graticule is custom-made for each microscope.

12. HSE/NPL phase contrast test slide, Mark II.

13. Telescope, ocular phase-ring centering.

14. Stage micrometer (0.01 mm divisions).

Sampling

1. Calibrate each personal sampling pump with a representative sampler in line.

2. Fasten the sampler to the worker's lapel as close as possible to the worker's mouth. Remove the top cover from the end of the cowl extension (open face) and orient face down. Wrap the joint between the extender and the monitor's body with shrink tape to prevent air leaks.

3. Submit at least two blanks (or 10% of the total samples, whichever is greater) for each set of samples. Remove the caps from the field blank cassettes and store the caps and cassettes in a clean area (bag or box) during the sampling period. Replace the caps in the cassettes when sampling is completed.

4. Sample at 0.5 L/min or greater. Do not exceed 1 mg total dust loading on the filter. Adjust sampling flow rate, Q (L/min), and time to produce a fiber density, E (fibers/mm²), of 100 to 1300 fibers/mm² ($2.85 \times 10^4$ to $5 \times 10^4$ fibers per 25-mm filter with effective collection area ($A_c = 385$ mm²)] for optimum counting precision (see step 21 below). Calculate the minimum sampling time, $t_{min}$ (min) at the action level (one-half of the current standard), L (f/cc) of the fibrous aerosol being sampled:

$$t_{min} = \frac{(Ac)(E)}{(Q)(L)10^6}$$

5. Remove the field monitor at the end of sampling, replace the plastic top cover and small end caps, and store the monitor.

6. Ship the samples in a rigid container with sufficient packing material to prevent jostling or damage.

Note.—Do not use polystyrene foam in the shipping container because of electrostatic forces which may cause fiber loss from the sampler filter.

Sample Preparation

Note.—The object is to produce samples with a smooth (non-grainy) background in a medium with a refractive index equal to or less than 1.46. The method below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison. Other mounting techniques meeting the above criteria may also be used, e.g., the nonpermanent field mounting technique used in P & CAM 239.

7. Ensure that the glass slides and cover slips are free of dust and fibers.

8. Place 40 to 60 ml of acetone into a Guth-type flask. Stopper the flask with a single-hole rubber stopper through which a glass tube extends 5 to 6 cm into the flask. The portion of the glass tube that exits the top of the stopper (8 to 10 cm) is bent downward in an elbow that makes an angle of 20 to 30 degrees with the horizontal.

9. Place the flask in a stirring hotplate or wrap in a heating mantle. Heat the acetone gradually to its boiling temperature (ca. 58 °C).

Caution.—The acetone vapor must be generated in a ventilated fume hood away from all open flames and spark sources. Alternate heating methods can be used, providing no open flame or sparks are present.

10. Mount either the whole sample filter or a wedge cut from the sample filter on a clean glass slide.

a. Cut wedges of ca. 25 percent of the filter area with a curved-blade steel surgical knife using a rocking motion to prevent tearing.

b. Place the filter or wedge, dust side up, on the slide. Static electricity will usually keep the filter on the slide until it is cleared.

c. Hold the glass slide supporting the filter approximately 1 to 2 cm from the glass tube port where the acetone vapor is escaping from the heated flask. The acetone vapor stream should cause a condensation spot on the glass slide ca. 2 to 3 cm in diameter. Move the glass slide gently in the vapor stream. The filter should clear in 2 to 5 sec. If the filter curls, distorts, or is otherwise rendered unusable, the vapor stream is probably not strong enough. Periodically wipe the outlet port with tissue to prevent liquid acetone dripping onto the filter.

d. Using the hypodermic syringe with a 22-gauge needle, place 1 to 2 drops of triacetin on the filter. Gently lower a clean 25-mm square cover slip down onto the filter at a slight angle to reduce the possibility of forming bubbles. If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours.

e. Clue the edges of the cover slip to the glass slide using a lacquer or nail polish.

Note.—If clearing is slow, the slide preparation may be heated on a hotplate (surface temperature 50 °C) for 15 min to hasten clearing. Counting may proceed immediately after clearing and mounting are completed.

Calibration and Quality Control

11. Calibration of the Walton-Beckett graticule. The diameter, $d_c$(mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

a. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.

b. Set the appropriate interpupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.

c. Install the 40 to 45 × phase objective.

d. Place a stage micrometer on the microscope object stage and focus the microscope on the graduate lines.

e. Measure the magnified grid length, $L_m$(mm), using the stage micrometer.

f. Remove the graticule from the microscope and measure its actual grid length, $L_a$(mm). This can best be accomplished by using a stage fitted with verniers.

g. Calculate the circle diameter, $d_c$(mm), for the Walton-Beckett graticule:

$$d_c = \frac{L_a \times D}{L_m}$$

Example.—If $L_a$ = 108 um, $L_m$ = 2.93 mm and D = 100 um, then $d_c$ = 2.71 mm.

h. Check the field diameter, D(acceptable range 100 mm ± 2 mm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (mm²).

12. Microscope adjustments. Follow the manufacturer's instructions and also the following:

a. Adjust the light source for even illumination across the field of view at the condenser iris.

Note.—Kohler illumination is preferred, where available.

b. Focus on the particulate material to be examined.

c. Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.

d. Use the telescope ocular supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric.

13. Check the phase-shift detection limit of the microscope periodically.

a. Remove the HSE/NPL phase-contrast test slide from its shipping container and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

Note.—The slide consists of seven sets of grooves (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7. The requirements for counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 to 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image quality deteriorates, clean the microscope optics and, if the problem persists, consult the microscope manufacturer.

14. Quality control of fiber counts.

a. Prepare and count field blanks along with the field samples. Report the counts on each blank. Calculate the mean of the field blank counts and subtract this value from each sample count before reporting the results.

Note 1.—The identity of the blank filters should be unknown to the counter until all counts have been completed.

Note 2: If a field blank yields fiber counts greater than 7 fibers/100 fields, report possible contamination of the samples.

b. Perform blind recounts by the same counter on 10 percent of filters counted (slides relabeled by a person other than the counter).

15. Use the following test to determine whether a pair of counts on the same filter should be rejected because of possible bias. This statistic estimates the counting repeatability at the 95% confidence level. Discard the sample if the difference between the two counts exceeds 2.77(F)$s_r$, where F = average of the two fiber counts and $s_r$ = relative standard deviation, which should be derived by each laboratory based on historical in-house data.

Note.—If a pair of counts is rejected as a result of this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts.

16. Enroll each new counter in a training course that compares performance of counters on a variety of samples using this procedure.

Note.—To ensure good reproducibility, all laboratories engaged in asbestos, tremolite, anthophyllite, and actinolite counting are required to participate in the Proficiency Analytical Testing (PAT) Program and should routinely participate with other asbestos, tremolite, anthophyllite, and actinolite fiber counting laboratories in the exchange of field samples to compare performance of counters.

Measurement

17. Place the slide on the mechanical stage of the calibrated microscope with the center of the filter under the objective lens. Focus the microscope on the plane of the filter.

18. Regularly check phase-ring alignment and Kohler illumination.

19. The following are the counting rules:

a. Count only fibers longer than 5 um. Measure the length of curved fibers along the curve.

b. Count only fibers with a length-to-width ratio equal to or greater than 3:1.

c. For fibers that cross the boundary of the graticule field, do the following:

1. Count any fiber longer than 5 um that lies entirely within the graticule area.

2. Count as ½ fiber any fiber with only one end lying within the graticule area.

3. Do not count any fiber that crosses the graticule boundary more than once.

4. Reject and do not count all other fibers.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 fields regardless of fiber count.

20. Start counting from one end of the filter and progress along a radial line to the other end, shift either up or down on the filter, and continue in the reverse direction. Select fields randomly by looking away from the eyepiece briefly while advancing the mechanical stage. When an agglomerate covers ca. ⅛ or more of the field of view, reject the field and select another. Do not report rejected fields in the number of total fields counted.

Note.—When counting a field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count.

Calculations

21. Calculate and report fiber density on the filter, E (fibers/mm²); by dividing the total fiber count, F; minus the mean field blank count, B, by the number of fields, n; and the field area, $A_c$ (0.00785 mm² for a properly calibrated Walton-Beckett graticule):

$$E = \frac{F - B}{(n)(A_c)} \text{ fibers/mm}^2$$

22. Calculate the concentration, C (f/cc), of fibers in the air volume sampled, V (L), using the effective collection area of the filter, $A_c$ (385 mm² for a 25-mm filter):

$$C = \frac{(E)(Ac)}{V[10^6]}$$

Note.—Periodically check and adjust the value of $A_c$ if necessary.

Appendix C to § 1910.1001—Qualitative and Quantitative Fit Testing Procedures—Mandatory

Qualitative Fit Test Protocols

*I. Isoamyl Acetate Protocol.*

A. Odor Threshold Screening

1. Three 1-liter glass jars with metal lids (e.g. Mason or Bell jars) are required.

2. Odor-free water (e.g. distilled or spring water) at approximately 25°C shall be used for the solutions.

3. The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1-liter jar and shaking for 30 seconds. This solution shall be prepared new at least weekly.

4. The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but shall not be connected to the same recirculating ventilation system.

5. The odor test solution is prepared in a second jar by placing 0.4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. Shake for 30 seconds and allow to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution may be used for only one day.

6. A test blank is prepared in a third jar by adding 500 cc of odor free water.

7. The odor test and test blank jars shall be labelled 1 and 2 for jar identification. If the labels are put on the lids they can be periodically peeled, dried off and switched to maintain the integrity of the test.

8. The following instructions shall be typed on a card and placed on the table in front of the two test jars (i.e. 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

9. The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

10. If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test may not be used.

11. If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

B. Respirator Selection

1. The test subject shall be allowed to pick the most comfortable respirator from a selection including respirators of various sizes from different manufacturers. The selection shall include at least five sizes of elastomeric half facepieces, from at least two manufacturers.

2. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject should understand that the employee is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape and, if fit properly and used properly will provide adequate protection.

4. The test subject holds each facepiece up to the face and eliminates those which obviously do not give a comfortable fit. Normally, selection will begin with a half-mask and if a good fit cannot be found, the subject will be asked to test the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are noted; the most comfortable mask is donned and *worn at least five minutes* to assess comfort. All donning and adjustments of the facepiece shall be performed by the test subject without assistance from the test conductor or other person. Assistance in assessing comfort can be given by discussing the points in #6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- Positioning of mask on nose.
- Room for eye protection.
- Room to talk.
- Positioning mask on face and cheeks.

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed.
- Strap tension.
- Fit across nose bridge.
- Distance from nose to chin.
- Tendency to slip.
- Self-observation in mirror.

8. The test subject shall conduct the conventional negative and positive-pressure fit checks (e.g. see ANSI Z88.2–1980). Before conducting the negative- or positive-pressure test the subject shall be told to "seat" the mask by rapidly moving the head from side-to-side and up and down, while taking a few deep breaths.

9. The test subject is now ready for fit testing.

10. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

11. The employee shall be given the opportunity to select a different facepiece and be retested if the chosen facepiece becomes increasingly uncomfortable at any time.

C. Fit Test

1. The fit test chamber shall be similar to a clear 55 gal drum liner suspended inverted over a 2 foot diameter frame, so that the top of the chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

2. Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

3. After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

4. A copy of the following test exercises and rainbow passage shall be taped to the inside of the test chamber:

*Test Exercises*

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side to the other. Inhale on each side. Be certain movement is complete. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Inhale when head is in the full up position (looking toward ceiling). Be certain motions are complete and made about every second. Do not bump the respirator on the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

*Rainbow Passage*

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

5. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

6. Upon entering the test chamber, the test subject shall be given a 6 inch by 5 inch piece of paper towel or other porous absorbent single ply material, folded in half and wetted with three-quarters of one cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

7. Allow two minutes for the IAA test concentration to be reached before starting the fit-test exercises. This would be an appropriate time to talk with the test subject, to explain the fit test, the importance of cooperation, the purpose for the head exercises, or to demonstrate some of the exercises.

8. Each exercise described in #4 above shall be performed for at least one minute.

9. If at any time during the test, the subject detects the banana-like odor of IAA, the test has failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

10. If the test is failed, the subject shall return to the selection room and remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber, and again begin the procedure described in the c(4) through c(8) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before ~~testing~~. Odor sensitivity will usually have ~~used~~ by this time.

~~If~~ a person cannot pass the fit test ~~scribed~~ above wearing a half-mask ~~espirator~~ from the available selection, full facepiece models must be used.

12. When a respirator is found that passes the test, the subject breaks the faceseal and takes a breath before exiting the chamber. This is to assure that the reason the test subject is not smelling the IAA is the good fit of the respirator facepiece seal and not olfactory fatigue.

13. When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test. To keep the area from becoming contaminated, the used towels shall be kept in a self-sealing bag so there is no significant IAA concentration buildup in the test chamber during subsequent tests.

14. At least two facepieces shall be selected for the IAA test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

15. Persons who have successfully passed this fit test with a half-mask respirator may be assigned the use of the test respirator in atmospheres with up to 10 times the PEL of airborne asbestos. In atmospheres greater than 10 times, and less than 100 times the PEL (up to 100 ppm), the subject must pass the IAA test using a full face negative pressure respirator. (The concentration of the IAA inside the test chamber must be increased by ten times for QLFT of the full facepiece.)

16. The test shall not be conducted if there is any hair growth between the skin the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e., multiple extractions without prostheses, or acquiring dentures,

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject,

(2) Date of testing,

(3) Name of the test conductor,

(4) Respirators selected (indicate manufacturer, model, size and approval number),

(5) Testing agent.

*II. Saccharin Solution Aerosol Protocol*

A. Respirator Selection

Respirators shall be selected as described in section IB (respirator selection) above, except that each respirator shall be equipped with a particulate filter.

B. Taste Threshold Screening

1. An enclosure about head and shoulders shall be used for threshold screening (to determine if the individual can taste saccharin) and for fit testing. The enclosure shall be approximately 12 inches in diameter by 14 inches tall with at least the front clear to allow free movement of the head when a respirator is worn.

2. The test enclosure shall have a three-quarter inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

3. The entire screening and testing procedure shall be explained to the test subject prior to conducting the screening test.

4. During the threshold screening test, the test subject shall don the test enclosure and breathe with open mouth with tongue extended.

5. Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

6. The threshold check solution consists of 0.83 grams of sodium saccharin, USP in water. It can be prepared by putting 1 cc of the test solution (see C 7 below) in 100 cc of water.

7. To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then is released and allowed to fully expand.

8. Ten squeezes of the nebulizer bulb are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

9. If the first response is negative, ten more squeezes of the nebulizer bulb are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

10. If the second response is negative ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

11. The test conductor will take note of the number of squeezes required to elicit a taste response.

12. If the saccharin is not tasted after 30 squeezes (Step 10), the saccharin fit test cannot be performed on the test subject.

13. If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

14. Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

15. The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least every four hours.

C. Fit Test

1. The test subject shall don and adjust the respirator without the assistance from any person.

2. The fit test uses the same enclosure described in IIB above.

3. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

4. The test subject shall don the enclosure while wearing the respirator selected in section 1B above. This respirator shall be properly adjusted and equipped with a particulate filter.

5. The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

6. A second DeVilbiss Model 40 Inhalation Medication Nebulizer is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

7. The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

8. As before, the test subject shall breathe with mouth open and tongue extended.

9. The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure using the same technique as for the taste threshold screening and the same number of squeezes required to elicit a taste response in the screening. (See B8 through B10 above).

10. After generation of the aerosol read the following instructions to the test subject. The test subject shall perform the exercises for one minute each.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side to the other. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete. Inhale when head is in the full up position (when looking toward the ceiling). Do not bump the respirator on the chest.

v. Talking. Talk loudly and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

*Rainbow Passage*

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

11. At the beginning of each exercise, the aerosol concentration shall be replenished using one-half the number of squeezes as initially described in C8.

12. The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected.

13. If the saccharin is detected the fit is deemed unsatisfactory and a different respirator shall be tried.

14. At least two facepieces shall be selected by the LAA test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

15. Successful completion of the test protocol shall allow the use of the half mask tested respirator in contaminated atmospheres up to 10 times the PEL of asbestos. In other words this protocol may be used to assign protection factors no higher than ten.

16. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e., multiple extractions without prothesis, or acquiring dentures,

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject,

(2) Date of testing,

(3) Name of test conductor,

(4) Respirators selected (indicate manufacturer, model, size and approval number),

(5) Testing agent.

*III. Irritant Fume Protocol*

A. Respirator selection

Respirators shall be selected as described in section IB above, except that each respirator shall be equipped with a combination of high-efficiency and acid-gas cartridges.

B. Fit test

1. The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize the subject with the characteristic odor.

2. The test subject shall properly don the respirator selected as above, and wear it for at least 10 minutes before starting the fit test.

3. The test conductor shall review this protocol with the test subject before testing.

4. The test subject shall perform the conventional positive pressure and negative pressure fit checks (see ANSI Z88.2 1980). Failure of either check shall be cause to select an alternate respirator.

5. Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part #5645, or equivalent. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure air pump set to deliver 200 milliliters per minute.

6. Advise the test subject that the smoke can be irritating to the eyes and instruct the subject to keep the eyes closed while the test is performed.

7. The test conductor shall direct the stream of irritant smoke from the tube towards the faceseal area of the test subject. The person conducting the test shall begin with the tube at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

8. The test subject shall be instructed to do the following exercises while the respirator is being challenged by the smoke. Each exercise shall be performed for one minute.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side to the other. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete and made every second. Inhale when head is in the full up position (looking toward ceiling). Do not bump the respirator against the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

*Rainbow Passage*

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

vi. Jogging in Place.

vii. Breathe normally.

9. The test subject shall indicate to the test conductor if the irritant smoke is detected. If smoke is detected, the test conductor shall stop the test. In this case, the tested respirator is rejected and another respirator shall be selected.

10. Each test subject passing the smoke test (i.e. without detecting the smoke) shall be given a sensitivity check of smoke from the same tube to determine if the test subject reacts to the smoke. Failure to evoke a response shall void the fit test.

11. Steps B4, B8, B10 of this fit test protocol shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agents.

12. At least two facepieces shall be selected by the LAA test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

13. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the PEL of asbestos.

14. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

15. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

16. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

17. Qualitative fit testing shall be repeated at least every six months.

18. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more.

(2) Significant facial scarring in the area of the facepiece seal.

(3) Significant dental changes; i.e.: multiple extractions without prothesis, or acquiring dentures.

(4) Reconstructive or cosmestic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

C. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent

*Quantitative Fit Test Procedures*

1. General.

a. The method applies to the negative-pressure nonpowered air-purifying respirators only.

b. The employer shall assign one individual who shall assume the full responsibility for implementing the respirator quantitative fit test program.

2. *Definition.*

a. "Quantitative Fit Test" means the measurement of the effectiveness of a respirator seal in excluding the ambient atmosphere. The test is performed by dividing the measured concentration of challenge agent in a test chamber by the measured concentration of the challenge agent inside the respirator facepiece when the normal air purifying element has been replaced by an essentially perfect purifying element.

b. "Challenge Agent" means the air contaminant introduced into a test chamber so that its concentration inside and outside the respirator may be compared.

c. "Test Subject" means the person wearing the respirator for quantitative fit testing.

d. "Normal Standing Position" means standing erect and straight with arms down along the sides and looking straight ahead.

e. "Fit Factor" means the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. *Apparatus.*

a. *Instrumentation.* Corn oil, sodium chloride or other appropriate aerosol generation, diluuon, and measurement systems shall be used for quantitative fit test.

b. *Test chamber.* The test chamber shall be large enough to permit all test subjects to freely perform all required exercises without distributing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air yet uniform in concentration throughout the chamber.

c. When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particular filter supplied by the same manufacturer.

d. The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000.

e. The combination of substitute air-purifying elements (if any), challenge agent, and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of PEL to the challenge agent at any time during the testing process.

f. The sampling port on the test specimen respirator shall be placed and constructed so that there is no detectable leak around the port, a free air flow, is allowed into the sampling line at all times and so there is no interference with the fit or performance of the respirator.

g. The test chamber and test set-up shall permit the person administering the test to observe one test subject inside the chamber during the test.

h. The equipment generating the challenge atmosphere shall maintain the concentration of challange agent constant within a 10 percent variation for the duration of the test.

i. The time lag (interval between an event and its being recorded on the strip chart) of the instrumentation may not exceed 2 seconds.

j. The tubing for the test chamber atmosphere and for the respirator sampling port shall be the same diameter, length and material. It shall be kept as short as possible. The smallest diameter tubing recommended by the manufacturer shall be used.

k. The exhaust flow from the test chamber shall pass through a high-efficiency filter before release to the room.

l. When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

4. *Procedural Requirements.*

a. The fitting of half-mask respirators should be started with those having multiple sizes and a variety of interchangeable cartridges and canisters such as the MSA Comfo II-M, Norton M, Survivair M, A-O M, or Scott-M. Use either of the tests outlined below to assure that the facepiece is properly adjusted.

(1) *Positive pressure test.* With the exhaust port(s) blocked, the negative pressure of slight inhalation should remain constant for several seconds.

(2) *Negative pressure test.* With the intake port(s) blocked, the negative pressure slight inhalation should remain constant for several seconds.

b. After a facepiece is adjusted, the test subject shall wear the facepiece for at least 5 minutes before conducting a qualitive test by using either of the methods described below and using the exercise regime described in 5.a., b., c., d, and e.

(1) *Isoamyl acetate test.* When using organic vapor cartridges, the test subject who can smell the odor should be unable to detect the odor of isoamyl acetate squirted into the air near the most vulnerable portions of the facepiece seal. In a location which is separated from the test area, the test subject shall be instructed to close her/his eyes during the test period. A combination cartridge or canister with organic vapor and high-efficiency filters shall be used when available for the particular mask being tested. The test subject shall be given an opportunity to smell the odor of isoamyl acetate before the test is conducted.

(2) *Irritant fume test.* When using high-efficiency filters, the test subject should be unable to detect the odor of irritant fums (stannic chloride or titanium tetrachloride ventilation smoke tubes) squirted into the air near the most vulnerable portions of the facepiece seal. The test subject shall be instructed to close her/his eyes during the test period.

c. The test subject may enter the quantitative testing chamber only if she or he has obtained a satisfactory fit as stated in 4.b. of this Appendix.

d. Before the subject enters the test chamber, a reasonably stable challenge agent concentration shall be measured in the test chamber.

e. Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half-mask and 1 percent for a full facepiece.

f. A stable challenge agent concentration shall be obtained prior to the actual start of testing.

(1) Respirator restraining straps may not be overtightened for testing. The straps shall be adjusted by the wearer to give a reasonably comfortable fit typical of normal use.

5. *Exercise Regime.* Prior to entering the test chamber, the test subject shall be given complete instructions as to her/his part in the test procedures. The test subject shall perform the following exercises, in the order given, for each independent test.

a. *Normal Breathing (NB).* In the normal standing position, without talking, the subject shall breathe normally for at least one minute.

b. *Deep Breathing (DB).* In the normal standing position the subject shall do deep breathing for at least one minute pausing so as not to hyperventilate.

c. *Turning head side to side (SS).* Standing in place the subject shall slowly turn his/her head from side between the extreme positions to each side. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

d. *Moving head up and down (UD).* Standing in place, the subject shall slowly move his/her head up and down between the extreme position straight up and the extreme position straight down. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

e. *Reading (R).* The subject shall read out slowly and loud so as to be heard clearly by the test conductor or monitor. The test subject shall read the "rainbow passage" at the end of this section.

f. *Grimace (G).* The test subject shall grimace, smile, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.

g. *Bend over and touch toes (B).* The test subject shall bend at the waist and touch toes and return to upright position. Repeat for at least 30 seconds.

h. *Jogging in place (J).* The test subject shall perform jog in place for at least 30 seconds.

i. *Normal Breathing (NB).* Same as exercise a.

*Rainbow Passage*

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

6. The test shall be terminated whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepieces. The test subject may be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate. (See paragraph 4.h.)

7. *Calculation of Fit Factors.*

a. The fit factor determined by the quantitative fit test equals the average concentration inside the respirator.

b. The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.

c. The average peak concentration of the challenge agent inside the respirator shall be the arithmetic average peak concentrations for each of the nine exercises of the test which are computed as the arithmetic average of the peak concentrations found for each breath during the exercise.

d. The average peak concentration for an exercise may be determined graphically if there is not a great variation in the peak concentrations during a single exercise.

8. *Interpretation of Test Results.* The fit factor measured by the quantitative fit testing shall be the lowest of the three protection factors resulting from three independent tests.

9. *Other Requirements.*

a. The test subject shall not be permitted to wear a half-mask or full facepiece mask if the minimum fit factor of 100 or 1,000, respectively, cannot be obtained. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

b. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

c. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

d. The test subject shall be given the opportunity to wear the assigned respirator for one week. If the respirator does not provide a satisfactory fit during actual use, the test subject may request another QNFT which shall be performed immediately.

e. A respirator fit factor card shall be issued to the test subject with the following information:

(1) Name.

(2) Date of fit test.

(3) Protection factors obtained through each manufacturer, model and approval number of respirator tested.

(4) Name and signature of the person that conducted the test.

f. Filters used for qualitative or quantitative fit testing shall be replaced weekly, whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily or sooner if there is any indication of breakthrough by the test agent.

10. In addition, because the sealing of the respirator may be affected, quantitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more.

(2) Significant facial scarring in the area of the facepiece seal.

(3) Significant dental change; i.e., multiple extractions without prothesis, or acquiring dentures.

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

11. *Recordkeeping.*

A summary of all test results shall be maintained in for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of the test conductor.

(4) Fit factors obtained from every respirator tested (indicate manufacturer, model, size and approval number).

Appendix D to § 1910.1001—Medical Questionnaires; Mandatory

This mandatory appendix contains the medical questionnaires that must be administered to all employees who are exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the action level, and who will therefore be included in their employer's medical surveillance program. Part 1 of the appendix contains the Initial Medical Questionnaire, which must be obtained for all new hires who will be covered by the medical surveillance requirements. Part 2 includes the abbreviated Periodical Medical Questionnaire, which must be administered to all employees who are provided periodic medical examinations under the medical surveillance provisions of the standard.

BILLING CODE 4510-26-M

MED-TOX ASSOCIATES INC.

# APPENDIX G

## INVESTIGATIVE OUTLINE

MED-TOX ASSOCIATES INC.

# ASBESTOS SURVEY
# INVESTIGATION OUTLINE
# S.C.R.T.D.
# 425 SOUTH MAIN STREET
# LOS ANGELES, CALIFORNIA

## I. Pre-Survey

A. Meet with SCRTD to review and discuss the following:

Clarify materials to be sampled - friable only? Non-friable?

1. Ask for and review "as built" drawings/blue prints;

2. Ask for and review building material specifications;

3. Review blueprints/specifications for:
   a. Hidden crawl spaces, pipe chases, or return and supply air plenums;
   b. Locations of mechanical rooms
      1) Type of HVAC/fans
      2) What floors do they service?
      3) Are there ducted returns or return air plenum?
      4) Hours of operation for HVAC.
   c. Locate boiler room/elevator room/emergency electric generator.
   d. Take specific measurements in square feet or lineal feet off of blueprints.
   e. Discuss sample location markings - does client prefer or object to physically labelling area sampled.

4. General useful information:
   a. When the building was built.
   b. Have any additions or renovations/remodeling been conducted?
   c. Who are the typical tenants?
   d. Response to building occupant inquiries.

5. Schedule the survey with the client.
   a. Preferably during nonoccupied or minimally occupied hours.
   b. Schedule an escort or contact, typically Building Maintenance.
   c. Arrange for parking, access to freight elevator, etc.
   d. Resolve any security problems.
   e. Stress access to all areas, non-representative areas must be waived if denied access.

B. Walkthrough

1. After presurvey meeting, it is helpful to conduct a walkthrough with the Building Manager to become familiar with the building. Note the following during walkthrough:
   a. Type of ceiling tile, e.g., 12" x 12" concealed splined.
   b. Telephone, electrical closets/rooms.
   c. Mechanical/Boiler Room.
   d. Floor and wall coverings.
   e. Parking Structure.
      1) Exposed insulated I-beams
      2) Insulated HVAC or exhaust ducting
   f. Visit and note roof composition
   g. Visit and note penthouse

C. Equipment and Documentation Preparation

1. Assemble all necessary sampling tools.
   a. Metal core-borer
   b. 25 mm. sample collection vials
   c. Pocket knife
   d. Flashlight
   e. Spray bottle with $H_2O$
   f. Spray adhesive
   g. Duct tape
   h. "Sharpie" ink pen
   i. Outside calipers - pipe diameter
   j. Wet wipes
   k. Baggies
   l. Camera film and flash
   m. Rolatape - Measure Master MKII
   n. Personal respirator and cartridges
   o. Tyvek (in car)

2. Assemble all necessary field forms
   a. Survey data forms
   b. Analytical request forms
   c. Reduced 8 1/2 x 11 floor plans

## II. SURVEY - BULK/AIR

### A. Survey Strategy

1. Visually inspect all rooms, pipe chases, crawl spaces, ceiling spaces, plenums, mechanical rooms, custodial closets, telephone closets, electrical closets, elevators, attics, stairwells, parking structures, roofs and roof equipment areas.

2. Identify functional spaces[1] and list all homogeneous materials within each functional space.

3. Sample all suspect asbestos-containing homogeneous material (except transite, none presence) as outlined below.

4. Photograph sample location (optional).

5. Assess physical condition, activity level, type material, friability, potential for air erosion, vibration and extent of damage.

6. Measure amounts of each homogenous material.

### B. Sampling Scheme/Protocol for Bulks (REFERENCE 1, 2)

1. At least three bulk samples shall be collected from each homogeneous area of surfacing material that is 1000 square feet or less.

2. At least five bulk samples shall be collected from each homogeneous area of surfacing material that is greater than 1000 square feet but less than or equal to 5000 square feet.

3. At least seven bulk samples shall be collected from each homogeneous area of surfacing material that is greater than 5000 square feet.

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[1] - functional space: spatially distinct units within a building which contain identifiable populations of building occupants.

4. Divide the homogeneous sampling areas[2] into required number of equal size subareas.

5. Collect samples from the center of each subarea.

6. At least three (3) samples of similar material should be collected during "random" sampling. Random samples include pipe insulation, hard pack elbows, tees, valves, floor and ceiling tiles, etc.

C. Collection Technique (bulk)

1. Collect samples while area is unoccupied.

2. Work in teams of two (2). One Industrial Hygienist to collect samples, visually inspect and dictate findings to the second I.H., who will document sample location conditions and label sample containers. Exception: buildings with surface area of 10,000 sq. ft. or less, one I.H.

3. All sample locations will be indicated on floor plans to further document sample collection points. If reduced floor plans are not available from the client, a simple site sketch shall be drawn by I.H.

4. Photographs may be required to document damaged ACM. Record roll and frame number on sample data sheet.

5. All I.H.'s will wear NIOSH-approved half-face respirators with HEPA cartridges during sample collection.

6. Wet the surface of the material to be sampled with water mist from a spray bottle.

7. Sample with a reusable metal boring tool with or without an extension for surfacing materials or a pocket knife in the case of pipe insulation, hard-pack elbows, and valves, etc.

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2 Boundaries or homogeneous sampling areas (i.e., areas containing surfacing materials that are uniform in texture and appearance) were installed at one time and are unlikely to consist of more than one type of formulation or mix.

8. With a twisting motion, slowly push the metal boring tool into the material. Be sure to penetrate any paint or protective coating and all the layers of the friable material*. Note the thickness of the ACM.

9. For reusable samplers, extract and eject the sample into the 25 mm. plastic sample vial. Wet wipe the tube and plunger. Firmly cap the sample container.

10. When sampling hard pack, carefully cut a "V" through the cloth wrap and extract approximately 10 grams of material into a 25 mm. plastic sampling vial. Firmly cap the sample container.

11. Label the container with the unique sample I.D. number that is marked on the sampling area diagram. Sample numbers are the sampler's initials, the date, then prefix B, then sequential number.

12. Finally use latex spray adhesive to cover the spot where the sample was taken.

* However, do not include distinctly separate materials in the same container, i.e., pipe cover wrap and actual pipe insulation.

12a. Duct tape should be placed over holes created in sampling pipe and boiler insulation.

13. Complete a sample data sheet for each homogeneous area. Do not move on without fully completing form.

14. Fill out the laboratory analysis request form and submit to the MED-TOX lab for analysis.

C. Sampling scheme/protocol for air

1. When ACM is found within the 50 air handling system or there is evidence of recent disturbance/spills of ACM, collect air samples for possible analysis by Transmission Electron Microscopy.

a. Sample is placed so to characterize ambient indoor air.

2. Numbers of samples to be collected as determined by the number of independent HVAC systems servicing a building.

D. Collection Technique (air):

1. Air samples for establishing background airborne asbestos fiber concentrations may be analyzed by TEM and collected in the following manner:

a. All samples are to be collected while the air handling system is on.

b. Air samples are collected by attaching an 0.8 micron pore-sized mixed cellulose ester filters, contained in a 3-piece 25 mm. cassette with a 2" conductive extension to a BGI high-flow sampling pump.

c. Utilizing a critical oviface to regulate air flow between 9-11 liters per minute. Document with rotometer actual flow rates before and after sampling.

d. Collect 1,500 liters to achieve the detection limits for TEM analysis.

e. Cassettes placed within tenant-occupied space, i.e., offices, warehouse, etc., must be set away from walls and at 4-6' above the ground.

f. Aggressive sampling required in areas which have undergone recent reconstruction or renovation.

E. Documentation

1. Record all pertinent data on field data sheets.

2. Floor plans 8 1/2 x 11. Record exact location of where bulk sample taken from. If floor plans are not available, make site sketches.

3. Completion of analytical request form.

## III. POST SURVEY/REPORT PREPARATION

A. After receiving results from lab, prepare an interim summary report for bulk and/or air samples .

B. Develop a final detailed report due on March 22, 1988.

C. Analyze data and evaluate homogeneous materials for hazard assessment based on physical inspection and occupancy usage patterns. Prioritize materials and recommend phased remediation and methods of remediation.

D. Final Report - To include:

1. Location of all ACM (descriptive/map).
2. The sample numbers of the materials in question.
3. The detailed location of that material.
4. The types of material.
5. The priority category that the material falls into for phased abatement.
6. Specific recommendations for abatement of each one of the items.
7. A discussion of development of an Operations and Maintenance Control Plan.
8. Regulatory requirements.
9. Conclusions.
10. Recommendations
11. Photographs (optional)
12. Laboratory analysis reports
13. Sampling and analytical methods

MED-TOX ASSOCIATES, INC.

## REFERENCES


1. Statistical support document for Asbestos in buildings simplified sampling scheme for friable surfacing materials, March, 1986.

2. Asbestos-containing materials in schools; proposed rule and model accreditation plan; rule 40 CFR 763, April, 1987

MED-TOX ASSOCIATES, INC.

# APPENDIX H

# INTERIM REPORT

MED-TOX ASSOCIATES, INC.

ENVIRONMENTAL & OCCUPATIONAL HEALTH SERVICES

1431 WARNER AVENUE • P.O. BOX 2054 • TUSTIN, CA 92681 • (714) 259-0620 • FAX (714) 259-0351

March 9, 1988

Mr. Phil Meyers
Facilities Engineering Department
S.C.R.T.D.
425 South Main Street
Los Angeles, California 90013

Dear Mr. Meyers:

Med-Tox Associates Inc. (MED-TOX) is pleased to submit the interim report for comprehensive bulk survey air monitoring survey performed at the S.C.R.T.D. facility located at 452 South Main Street, Los Angeles, California. This survey was conducted between February 23-26, 1988.

If you have any questions or desire additional information please feel free to contact me at our Tustin Office.

Sincerely,

Al Perez, MPH, CIH, CSP
Director
Industrial Hygiene Services

Enclosure:
AP/mb:R406/24
3105

MED-TOX ASSOCIATES INC.

## INTRODUCTION

On February 23 though 26, 1988, Med-Tox Associates Inc. (MED-TOX) conducted a comprehensive bulk survey and air monitoring for the presence of asbestos containing material (ACM). The Southern California Rapid Transit District (SCRTD) buildings where the survey was performed are located at 425, 415, and 411 South Main Street and 124 Fourth Street in Los Angeles, California. The survey team was comprised of industrial hygienists who have experience in the recognition and evaluation of ACM. The survey team worked under the supervision of Mr. Al Perez, Certified Industrial Hygienist.

## SUMMARY OF RESULTS

The majority of ACM was found in the pipe insulation, sprayed-on fireproofing, and nine-by-nine floor tile. No ACM was detected in the ceiling tiles located throughout the facility. Other materials that were sampled, but did not contain ACM were: twelve-by-twelve floor tiles, wall plaster, and sprayed on fire-proofing on the forth floor of Annex C.

## BULK SAMPLE RESULTS

### Boiler Room - Basement

Several samples were collected of insulation materials on the pipe runs and elbows, on the hot water tank, and the Superior Heat Exchanger. The sample results ranged from 5 to 80 percent asbestos in the form of either chrysotile, amosite, or crocidolite. The ACM in the boiler room was in poor condition, a sample of debris collected off the floor under the main exhaust duct was found to be 80 percent chrysotile. The main exhaust duct should be considered a high priority area. The ACM should be removed by a licensed and certified asbestos abatement contractor.

### Fan Room (Basement)

The fan room located in the basement contained ACM on pipe elbows. The majority of pipe runs were insulated with fiberglass. The sample results ranged from no asbestos detected to 40 percent asbestos. Various pipes in the fan room have been abandoned. Some of the abandoned pipes have been sawed off, leaving exposed areas of ACM. The insulation in the fan room is in poor condition, and is a high priority area. The ACM should be removed by a licensed and certified asbestos abatement contractor.

Fan Rooms - Annex 2 - (425 South Main Street)

The fan rooms located in Annex 2 on each floor contains ACM ranging from 5 to 40 percent asbestos. All pipe insulation was in good condition in all Annex 2 fan rooms. The material should be maintained and periodically re-inspected to assure that it remains in good condition.

Annex 2 - (425 South Main Street)

Sprayed on fireproofing on the second, third, fifth and sixth floors of Annex 2 contained ACM ranging from 20 to 30 percent chrysotile. Although the material is friable (easily crumbled by hand pressure) it was in good condition at the time of the survey with very minimal debris on the suspended ceiling. An air handling unit in the basement of the building contained insulated pipe elbows with ACM ranging from 5 to 30 percent asbestos. The air handling unit has lines servicing the fan rooms of Annex 2.

Annex 2 contained vinyl asbestos tile (VAT), nine-by-nine floor tiles ranging from no asbestos detected to two (2) percent. All tile was in good condition and does not present an airborne fiber hazard in its present condition.

Annex 1 - (415 South Main Street)

Annex 1 contained sprayed-on fireproofing on the second, third, fourth, and sixth floors with ACM results ranging from 5 to 30 percent asbestos. Other ACM in Annex 1 was pipe insulation in the fan rooms on the fourth floor. The chilled water lines contained asbestos elbows and fiberglass straights, the low pressure steam pipes were entirely ACM, the sample results ranged from 15 to 40 percent asbestos. The west fan room had some debris on the floor that is possibly ACM from deteriorating pipe insulation. The damaged insulation should be removed by a licensed and certified asbestos abatement contractor. The remaining floors of Annex 1 contain air handling equipment in a center core unit. The units contain ACM on the elbows of pipes with fiberglass straights. The center core units were in good condition. There were VAT that contained asbestos from trace to five (5) percent.

Annex's A, B, C - (411 South Main Street - excluding first and second floors)

The majority of ACM in Annex's A, B, and C was located in the pipe insulation and sprayed-on fireproofing on the fifth floor of Annex's A and B. The fourth floor contained fireproofing that was non-detectable for asbestos. The third floor of Annex's A, B, and C had no sprayed-on fireproofing. Domestic hot water

pipes run throughout the building from the basement up through Annex C, outside the restrooms. Other ACM in Annex's A, B, and C were VAT.

Annex's D, E, and F - (124 Fourth Street - excluding floors one through three)

Very little ACM was detected in Annex's D, E, and F. There was one section of sprayed-on fireproofing on the fourth floor that apparently was not removed during a removal that contained five (5) percent chrysotile asbestos. The material was in good condition, however, there were ceiling tiles missing that exposed the fireproofing. The material was located between column lines seven and eight (7 & 8) to the north corridor.

The seventh floor of the 124 Fourth Street Building is not occupied by RTD, however, a sample of pipe insulation that was in very poor condition was collected and found to be ten (10) percent chrysotile asbestos. Several pieces of the insulation was on the ground and should be cleaned up by an abatement contractor, and the remaining insulation on the pipe should be removed as it could present a fiber hazard to the RTD facility.

Roof

ACM on the roof was in the form of roofing material, pipe insulation, and transite cooling towers. The sample results ranged from no asbestos detected (method detection limit is one (1) percent) to 50 percent asbestos. The ACM inside the chiller and boiler rooms was in condition. The ACM outside on the roof that has been exposed to the elements were in poor condition. The cooling tower that is no longer in service contained transite panels that were in poor condition. The silver roofing material throughout the roof contained one (1) percent asbestos.

SUMMARY OF AIR MONITORING RESULTS

Phase Contrast Microscopy (PCM)

A total of 47 PCM samples were collected. PCM counts all fibers that are greater than five (5) microns in length and have a length to width ratio of three to one (3-1) or greater. PCM does not differentiate between asbestos and non-asbestos fibers. All 47 samples were less than 0.01 fibers per cubic centimeter (f/cc) of air sampled. The Environmental Protection Agency (EPA) recommends a re-occupancy fiber level of 0.01 f/cc following an asbestos abatement activity or any job that disturbs ACM.