# EQUIPMENT AND PROCEDURES FOR MOUNTING MILLIPORE FILTERS AND COUNTING ASBESTOS FIBERS BY PHASE CONTRAST MICROSCOPY

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## INTRODUCTION

For several years, a set method for counting and sizing airborne particulate matter, which has been deposited upon membrane filters, has been used. The filters used in this technique are 37 mm diameter cellulose ester membrane filters manufactured by Millipore Corporation, (cat. no. AAWP03700). The slide mounting technique refers only to these filters and will not work for any others.

The filters may be purchased premounted in convenient field monitor cases, and are ready for sampling. The filters are nearly 100% efficient for any asbestos dust, even for fibers with diameters much smaller than th 0.8 micron (μ) pore size. Sample preparation for electron and optical examination are both relatively simple. Slide mounts of the filters are semi-permanent.

The following procedures and recommendations will produce accurate results, if each step is performed exactly as indicated.

## EQUIPMENT LIST

1. Table
2. Adjustable chair
3. Phase contrast microscope
4. Ribbon filament illuminator or (built-in illuminator)
5. Eye piece reticle (Porton type)
6. Lens tissue
7. Small camels hair brush
8. Slides
9. Cover slips
10. Spatula
11. Tweezers
12. Scalpel
13. Wheaton Balsam bottle

## LABORATORY SET-UP

It is important to provide a suitable counting area, for the room in which the counting is to be done has a great bearing upon the microscopist. It should be out of the way of normal traffic, and be kept as free from dust and smoke as possible. The tables on which the microscopes are place shoul be as free from vibrations and shocks as possible. An adjustable chair wil do much to add to the comfort of the counter.

PRELIMINARY MICROSCOPE SET UP

Before any dust sizing or counting can be done, proper equipment must be at hand. This section describes the required equipment.

The illuminator should be small and reasonably compact. Ribbon filament illuminators are generally much easier to use. The illuminator must incorporate a condensing lens, so that the enlarged image of the lamp filament may be focused in the plane of the substage condenser diaphragm. The illuminator must also have an iris diaphragm located as near as possible to the condensing lens. The iris serves as a field diaphragm and is focused in the plane of the specimen.

The microscope used must have a substage condenser fitted with an iris diaphragm. This iris serves as an aperture diaphragm. The microscope should have a calibrated reticle inside the non-adjustable eyepiece. The reticle should be small enough that all the counting field is in focus (if the flat field objective and eyepieces are used, essentially the entire field will be in focus). The microscopes must be equipped with phase contrast accessories. Using phase contrast, even objects with almost the same refractive index as the mounting media can be seen. Light waves which travel through such a specimen are retarded by a fraction of a wavelength to produce a change in phase. The phase contrast optical system reveals these phase changes as light or dark contrast against the background.

This procedure was written by a user of Bausch and Lomb phase-equipped microscopes, so that microscope set-up procedures correspond with these. However, any good microscope with phase contrast accessories will be satisfactory.

For continual routine examination of filters, the binocular type microsco: is much more comfortable. The use of a first surface mirror is recommend but not necessary.. By utlizing a second surface mirror, multiple images of the illuminator field iris are formed which will detract from the cris: ness of the final image.

As mentioned previously, the microscope must contain a reticle. Any reti such as the Porton or Patterson Globe and Circle, which projects a consta: counting area and has provision for sizing, will work. The Porton reticl which we use outlines a rectangle that fits easily within the periphery o focus. The rectangle is divided into two squares. The left square is divided into six rectangles which constitutes the counting area. Above a: below the large rectangles are a series of circles in which every other c doubles in diameter. Hence,the third is twice the diameter of the first; the fourth is twice the size of the second, etc. The right half of the r tangle contains a scale for extending the size above the number nine circ The formule $D=L\sqrt{2^N}$ describes the circles sizes. The diameter D is foun from L which is the unit of length, and N which represents the number of circle. L is determined by calibration with a stage micrometer. The ent

length of the rectangle is 200 L units. By measuring the length and divid by 200, "L" is obtained and the circle sizes may be calculated. Whenever microscope is disassembled or cleaned, the reticle calibration should be checked. Another fact to take into consideration is that changing the int pupillary distance of the binocular will change the calibration, so the microscopist may want to check the calibration at both extremes of adjustment. The counting area on the reticle should be kept as clean as possibl as dirt on the reticle is in focus and may be counted.

## MICROSCOPE SET UP AND THE PROCEDURE FOR OBTAINING KOHLER ILLUMINATION

By utilizing equipment that meets the requirements just mentioned, any counter may achieve comparable counts after some practice. This section will deal with setting the microscope up and obtaining kohler illumination It is extremely important that every step be followed exactly as indicated.

1. Place the microscope on a flat, level surface at a height such that the eyepieces may be observed without strain or discomfort.
2. Place a moderate dust sample upon the stage.
3. Place the illuminator directly in front of the microscope. Sight across the two and be sure they are aligned. For coil filament bulbs the illuminator iris should be two inches from the center the microscope mirror. For ribbon filament bulbs, the front of the filter holder should be seven inches from the center of the plane side of the mirror. Never use the curved side.
4. Remove all diffusing filters from the system and insert a neutra density filter and a clear blue filter. Blue or green colored f ters may be used at the discretion of the microscopist.

NOTE: Where the microscope includes a built-in illuminator to give Kohler illumination, the above steps will not all be necessary.

## REVIEW

A. Check microscope and illuminator alignment.

B. Check the distance between the microscope and the illuminator.

C. Be sure that you are using the flat side of the mirror.

D. Make sure that there are only two filters in the system.

5. By means of the focusing knob on the side of the substage condenser assembly, raise it until the upper lens nearly touches the bottom of the slide. Remember that the free working distanc of the condenser is in the order of 1.2 mm and that the slide is about 1 mm thick.

6. Turn on the illuminator. Using the tilt controls, direct the beam onto the center of the micrror. Then by tilting the mirro direct the beam upward into the condenser.
7. Close the substage iris completely. Open the illuminator iris all the way.
8. By means of the focusing controls on the side of the illuminato focus the image of the filament on the bottom of the substage i This may be done by leaning over the microscope and observing t substage iris in the microscope mirror. (On such models as the Bausch & Lomb PR-27, there is a fine focus knob at the rear of the illuminator). In that case, move the condensing lens all t way forward and trim the focus with the fine focus knob.
9. Open the substage iris about half way.

REVIEW

A. Check the distance between the slide and condenser.

B. Be sure that the beam is striking the center of the mirror, and that i is being deflected upward into the condenser.

C. Please repeat step 7.

D. Check step 8. If the image is not in focus now, correct it. Do not continue until the filament is correctly focused.

E. Please repeat step 9.

10. Put the 10X objective in place and focus on the sample. This is done as follows: First, looking from the side of the microscope lower the objective until it gets very near to the slide. Then, by looking through the eyepieces, focus up. Never focus down w coarse focus when looking through eyepieces.

A word of caution: The objective lenses are very expensive, so be careful to grind them through the slide. Always focus up. Now trim the focus with fine focus knob. Focus sharply on the sample. Secondly, close the field i fully. If the condenser is nearly in focus, you should see a bright spot c light. By using the condenser focus knob, bring the field iris into sharp focus. Now, both the field iris and the objective are in focus on the samp If there appear to be multiple images of the field iris, it is because of t second surface mirror. Some of the light waves are reflected from the firs surface, resulting in secondary images.

11. If the image of the field iris is not centered, re-center it by tilting the mirror. If the color around the field iris is not uniform, re-check the tilting of the illuminator.

REVIEW

A. Check and be sure you are focused on the sample. 10X objectives have a relatively long focal length and it may be possible to focus on: (a) the top of the cover slip. (b) the sample. (c) the bottom of the filter. (d) the top of the slide. (e) the bottom of the slide. (f) the top of the condenser. So be sure of the focal plane.

B. Be sure that the field iris is focused in the sample plane. Check thi often when examining samples. As the sample focus changes, so does th condenser focus.

C. Re-check the centering and tilt of the illuminator.

DETAILED INSTRUCTIONS FOR BAUSCH AND LOMB BINOCULAR MICROSCOPES

1. Leave the microscope phase ring on 0. Insert the telescope that is supplied with the kit into the right eyepiece tube. Focus on the dark phase ring. Open and close the substage iris to be sure that it is centered in relation to the objective phase ring. If it is not in the center, loosen the set screw on the condenser mount and properly set the condenser. Then re-tighten the set screw. This should very seldom be necessary. Do not force anything and be careful and patient. When you are satisfied that the condenser is aligned, open it all the way.

2. Turn the phase wheel to 10. This shows that the 10X phase ring is in place. Look through the telescope again. By using the adjustment scre on the side of the condenser, move the rings, until they are perfectly concentric. When changing phase rings, move them carefully, so as not to knock the condenser out of alignment.

3. Turn to the 43X objective. Carefully turn the wheel to the 43 phase ring. Align the two rings in the same manner as performed in step 2.

4. Remove the telescope and replace the eyepieces. Again, check the conde ser focus. You are now ready to examine the sample at 430X, assuming that you are using 10X eyepieces.

FILTER MOUNTING

Set up Prior to Mounting

Have available at hand a quality scalpel and a supply of No. 10 curved blade a pair of tweezers (fine pointed are preferred), a spatula or fire polished glass rod and a box of lens tissue. Slides (1" x 3" or 25 x 75 mm) with

the date, sample number, etc. It is advisable to use quality number 1-1/2 cover slips. Most dry objectives are corrected for this thickness cover glass. The mounting media should be kept in a Wheaton Balsam bottle. The edge around the lid should be coated with stopcock grease to keep out the surrounding air.

The mounting solution may now be prepared. A one to one solution by volum of dimethyl phthalate and diethyl oxalate is poured into the balsam bottle Then add 0.05 gram of filter material for each milliliter of solution. Th added filters increase the viscosity of the solution. Before using the solution, all of the filter material must be dissolved and the solution mu be of uniform consistency. This may require a day or so with frequent sti ring. Refrigeration may add to the shelf life of the solution.

Mounting Procedure

Keep in mind that cleanliness is important. First, lay down two pieces of lens tissue; one directly in front of you and the other to the left or rig for the mounting tools. Next, wipe the scalpel, tweezers and glass rod or spatula with the frosted end toward you. Even precleaned slides must be cleaned this way. Hold a cover slip by the edges between the index finger and the thumb, and clean it in the same manner as the slide.

Place the cover slip so that one edge rests on the unfrosted end of the slide and the other edge rests on the lens tissue. Be sure that the lower surface does not come into contact with the lens tissue.

Using the glass rod, or dropper, dispense a small drop of the mounting med onto the center of the slide. Replace the rod or dropper into the solutic bottle and cover it. Using the spatula, spread the solution into a triang shape. While the fluid is spreading, cut a wedge of corresponding size fr the filter. Place it upon the mounting media, sample side up. Pick up th cover slip and place it on top of the filter. Press lightly on the cover slip to be sure the mounting media has made contact with it. Label the sl before completing any other slide. Sometime, after an hour or so, the fil may not have cleared. Usually, this can be cured by pressing lightly on t cover slip with a pencil eraser that has been wrapped with lens tissue. I the filter has been used to filter liquids or is damp, it will require dry for it will not clear unless completely dry.

Use only enough solution to clear the filter. If too much solution is use the sample may spread and give an erroneous count per unit area. The filt should be counted as soon as possible because the solution may eventually form crystals that look like fibers and may be mistaken for part of the sample.

After a little practice and experience, several samples may be mounted at the same time with excellent results.

Remember to keep the area in which mounting is done as clean as possible to prevent contamination of the filter.

MICROSCOPE PRECAUTIONS AND MAINTENANCE

Quality lens tissue is a must. The microscopist should use it for any kind of lens cleaning. It should be as lint free as possible. It may be wrapp around the blunt end of a small camels hair brush and used to clean the ey nieces. Never wipe the inside of the microscope body. If it is necessary to remove dirt from the inside of the tubes, blow it out with an aspirator bulb. Whenever you are using immerision oil, be sure that you wipe all surfaces that were in contact with the oil.

Generally, solvents should not be used when cleaning lenses. Alcohol, lik most solvents will dissolve the lens mounting cement, which may ruin the lens system. Xylene should be used sparingly to remove immersion oil.

Use a camels hair brush to clean first-surface mirrors and non-critical le surfaces. Never wipe first-surface mirrors with lens tissue.

Avoid touching a lens surface with fingers as the finger prints has a tendency to etch into the lens surface.

COUNTING PROCEDURE

Place the sample on the stage and focus on it. Since the sample is retain in the top ten fifteen microns of the filter, be sure that you are focused in the proper plane. The reticle in the left eyepiece is used to define the counting area. The reticle should be calibrated prior to being used. The total fiber count (a fiber is anything three times as long as it is wide) should be at least 100 fibers, or twenty fields, whichever is less. It is advisable to make as large a count as practical to get an accurate average. If a fiber corssed the limits of the counting field, only those crossing either or both of two adjacent sides are counted. For example, a fiber crosing the top or right, or possibly both sides would be counted. The sides chosen are at the discretion of the counter, but any counter mus always use the same sides. The fibers counted are estimated as to length, using the circles at the top of the reticle. Our practice has been to record all fibers seen, all fibers longer than five microns and all fibers longer than 10 microns. However, for comparison with the ACGIH TLV (1968) only the longer than 5u fibers need be counted.

FIELD MONITOR DISCUSSION

Membrane filters may be purchased pre-loaded in plastic holders (Aerosol Analysis Monitors). The Monitors consist of three sections. The filter is held between the middle and bottom sections. Between the membrane filter and the bottom section lies a support pad. The calibrated pump, designed to draw a known and constant supply of air, is always connected to the bottom of the field monitor case. When many loaded cases are taken into one particular area for sampling, a blank or control filter (meaning a loaded field monitor case) should be taken out to the area, brought back unused and counted. This will determine what degree of general contamination is present on the filters. We have found that banding the field monitor cases with cellulose bands greatly reduces the general contamination of the filters. The bands may be purchased from Walter H. Jelly and Company, Inc. They are white, opaque, size 41 x 25 and come packed in solution S-132. Upon removal from the solution, the bands are slipped around the middle and bottom joints, or around all joints, depending upon whether the sample is going to be drawn through the top section plug hole, or the entire top section removed for "open" sampling. The latter procedure is recommended for asbestos dust sampling since it results in a more even sample distribution over the entire exposed filter surface.

Convenient personal sampling pumps, such as those distributed by Mine Safety Appliances Company, Willson Products Division or Union Industrial are excellent for short term, low rate (around 2 lpm) sampling. A sampling pump is connected to a 3 foot length of non-collapsable, one quarter inch, rubber tubing with a male Leur slip adapter (stock number LH/ available from Becton, Dickson and Company) inserted into the other end. This enables one to connect the hose directly to the case by simply inserting the adapter into the plug hole at the bottom of the case.

Field monitor cases may easily be re-used. The plugs and all sections are separated and placed in warm detergent water. The parts should be scrubbed thoroughly and rinsed in tap water. However, if the filters are to receive any chemical analysis, the cases should also be rinsed in distilled water. The cases should be allowed to dry in a clean area (a clean room is preferable), to reduce contamination. The clean area is equally important when loading the filters into the cases. The filter pad (the thicker, fibrous disc) is placed in the bottom section. The filter is placed directly on the pad. The middle and top sections are added, the case is pressed tightly together, and the top plug is inserted. Replacement of the bottom plug is not necessary. A cellulose band is then place around the case and after the band dries, the unit is ready for sampling. Sample code numbers, etc. may be written on the band or upon the filter case, first making sure the markings can be removed when and if it is necessary.

Additional information concerning filters and field monitors may be obtained from Millipore Corporation.

CALCULATION OF CONCENTRATION

When a sample is taken, pertinent information about the sample should be recorded at the sampling site. First, the sample number should be written on the field monitor case and the sample ticket. Next, enter a description of his operation in the appropriate space. If the sample is a general air sample and does not pertain to any particular employee, write "general air sample" in the employee's name space. Information about the area may be written in the "description of operation" space. If you have several pumps which are identical in appearance, but have different flow rates, it would be a good idea to assign them instrument numbers. This enables you to keep accurate records of maintenance and calibration. When instrument numbers are kept it is not necessary to enter the flow rate at the sampling site. It may be entered later from the record cards. Otherwise, enter the flow rate at the sampling site. When a number of filters are taken into a general area a control (or blank) is taken along. This should be assigned a number and entered in the blank number space. Do not assign blank filters duplicate numbers.

When the sampling pump is turned on, enter the time in the "time on" space. While the sample is being taken make notes of controls, i.e. exhaust hoods, fans, window ventilation, etc. These notes should be entered in the "description of controls". The sample should then sign his name or initial at the bottom of the sheet.

After sufficient time has passed, the sampling instrument should be turned off and the time recorded in the "time off" space. The difference between "time on" and "time off" should be expressed in minutes and should be entered in the "total time" space. The "total air volume" may be found by multiplying the flow rate (expressed liters per minute) by the total time and recorded in the appropriate space.

After the sample has been taken, brought back into the lab and mounted, the counting procedure is next.

The microscope must be properly set up. Place the slide to be counted on the mechanical stage. Focus on the sample a short distance away from the edge. Never count close to the edges of the filter because the filter will spread a little and lower the count. Now, enter the date, sample number, blank number and field area on the count sheet. The counter should initial the form in the "initial" space. The sized fibers are entered from right to left across the form, first entering the >10μ fibers, then the >5μ fibers and finally, all fibers seen, called the total. After 100 fibers or 20 fields are counted and recorded, all of the vertical columns are added up and the totals are entered under their corresponding columns. Divide the totals at the bottom by the number of fields counted to determine the average number of fibers per size range per field. By using information on these two sheets the concentration in fibers per cubic milliliter may be calculated and entered in the "con." space on the count sheet.

$$\text{Concentration} = \frac{(\text{Av. Fiber Cnt.})\ (\text{filter area})}{(\text{field area})\ (\text{Sample volume})\ (1000)}$$

| | |
|---|---|
| Av. Fiber Count: | Average fiber count per size range |
| Filter area: | 855 $mm^2$ for 37 mm dia. membrane filters |
| Counting area: | Reticle calibrated in $mm^2$ |
| Sample volume: | total time x flow rate, express in liters |
| 1000: | Converts liter to milliliters |

If blanks are used, subtract the average blank cout of the same size range from the average fiber count.

## ADDRESSES

Millipore Field Monitor Cases (complete)
Cat. No. MAWP 037A0
Millipore filter (W. Pads)
Cat. No. AAWP03700
Millipore Filter Corporation
Bedford, Massachusetts 07130

Porton Reticle
Cat. No. 30084
Patterson Globe & Circle Reticle
Cat. No. 30083
Edmund Scientific Co.
701 Edscorp Building
Barrington, New Jersey 08007

Wheaton Balsam Bottle
Cat. No. 2244
Arthur H. Thomas Company
Post Office Box 779
Philadelphia, Pennsylvania 19105

Adapters, hose end for 1/4" tubing to male leur slip
Cat. No. LH/L
Becton, Dickinson and Company
Rutherford, New Jersey

White, opaque, cellulose bands, 41 x 25
No. 28
Walter H. Jelly & Co., Inc.
2822 Birch Street
Franklin Park, Illinois 60131

Personal Sampler Mk. II
Willson Products Division
Reading, Pennsylvania

Monitaire Sampler
Mine Safety Appliances Co.
Pittsburgh, Pennsylvania

Unico Telematic Model C-110
Unico Environmental Industries, Inc.
Fall River, Massachusetts

INST. _____ FLOW RATE _____ BLANK _____

TIME ON _____ TIME OFF _____

TOTAL TIME _____

TOTAL AIR VOLUME _____

EMPLOYEES NAME _____

JOB TITLE _____

DESCRIPTION OF OPERATION

DESCRIPTION OF CONTROLS

INITIALS _____

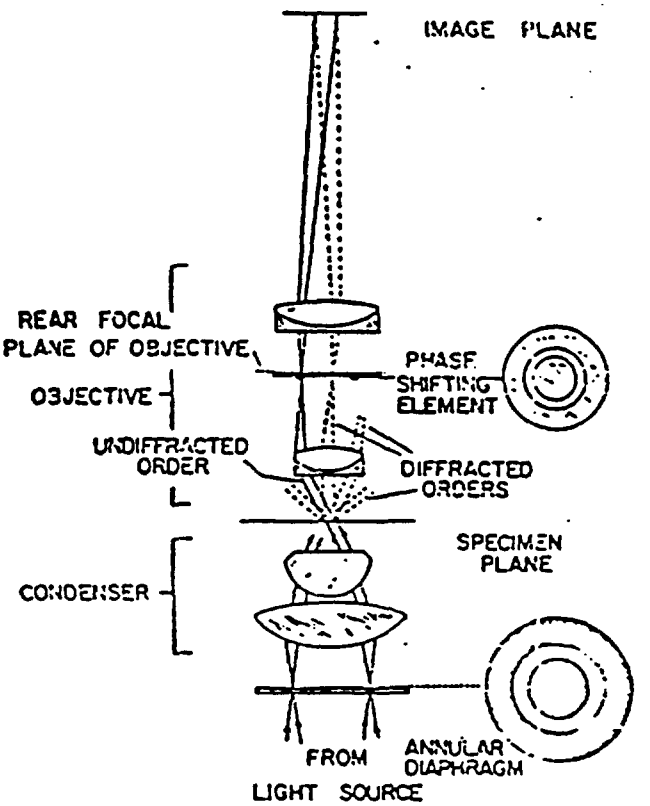
SAMPLE TICKET

FIELD AREA _____ BLANK _____

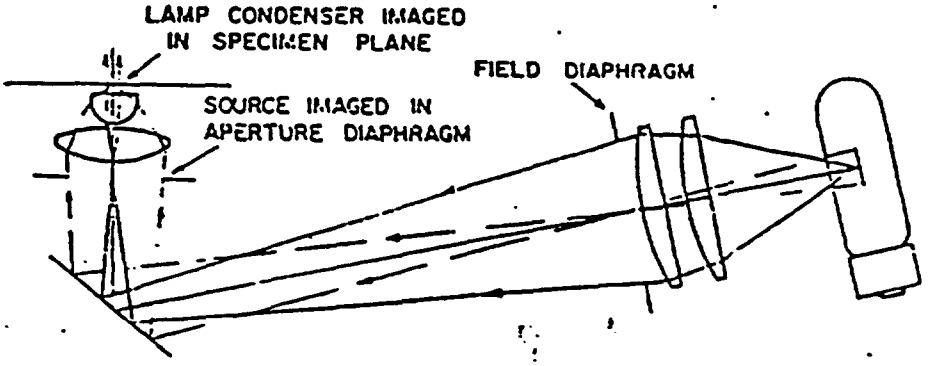
INITIALS _____ CONCENTRATION _____

| | TOTAL | FIBERS >5 μ | >10 μ |
|---|---|---|---|
| TOT | | | |
| AV. | | | |

COUNT SHEET




PHASE CONTRAST MICROSCOPE




KOEHLER ILLUMINATION

WRITE ON HARD, SMOOTH SURFACE WITH BALL POINT PEN OR A SHARP PENCIL.

NO ADDRESSED ENVELOPE NECESSARY. FOLD AT MARKS FOR STANDARD #9 OR #10 WINDOW ENVELOPE.

TO (PRINT) J. J. Doyle

FROM (PRINT) Gene Polk

SUBJECT: Jaquays Asbestos MF7

DATE OF MESSAGE: 4/8/74

DATE OF REPLY:

Loyd Hill's memo about Jaquays asbestos is attached.

We have asked Jaquays about an exclusive on this product for drilling mud use.

Jaquays now wants us to guarantee a purchase of 3000 - 50# bags per year.

This finely ground asbestos can be purchased from Jaquays at Globe, Arizona in 1½ ton pallets, strapped and red labelled.

~~Are you interested in this arrangement?~~

GP:fk

I don't believe we should market this because of OSHA regulations. Also we don't need it.

ORIGINATOR: SEND WHITE & YELLOW INTACT, RETAIN PINK

RECIPIENT: REPLY BELOW, RETAIN WHITE & RETURN YELLOW COPY TO THE ORIGINATOR.

ORIGINATOR: DETACH THIS WITH PRECEDING CARBON BEFORE MAILING WHITE AND YELLOW

TO (PRINT) Glenn Poirier.
C.C. D. Beaumont
L.D. Lloyd

FROM (PRINT) J. McLellan

SUBJECT Jaguars / Asbestos (Total)

DATE OF MESSAGE 4/17/74

DATE OF REPLY / /

Reference your memo of 4/8/74 and Lloyd Hutto's of 4/4/74.

As you are aware there are still problems with asbestos handling regulations - In view of this and since we could get Total I do not think we should agree to take this guarantee from Jaguars - Also it is my understanding that Lloyd are selling very little - ~~The~~ We are hopeful of a basic product improvement (dustless) from Total soon -

JMcL

A4

DISCARD WHEN YELLOW IS RETURNED WITH FULL REFERENCE TO MESSAGE AND REPLY.
ORIGINATOR: DETACH THIS WITH PRECEDING CARBON BEFORE MAILING WHITE AND YELLOW

December 20, 1972

Through OSHA, stringent regulations are now in effect on the use of asbestos. The impact of these regulations on the drilling industry has, until now, been a source of concern and confusion to suppliers as well as users. Several months ago, we at Montello determined to ascertain how our wet processed Super Visbestos would perform, in the context of the OSHA regulations, under the widely varying conditions found on drilling rigs. With the invaluable assistance and cooperation of several companies, these on-site tests and their evaluation have now been completed.

Attached are copies of the reports on each of four field tests, as well as an interpretive analysis of these reports. Site selection was based on a desire to evaluate the broadest possible range of dumping environments. During the tests a radically new granular form of Super Visbestos was also evaluated.

Certain points are worthy of special note at this time.

1. All tests were performed on Montello's exclusive, wet processed asbestos products. The data and results cannot be safely applied, therefore, to any of the several dry ground products on the market.

2. On all tests, Super Visbestos consistently fell well below the present OSHA regulations as to maximum ceiling limit and 8-hour time weighted average.

3. The New Granular form of Super Visbestos proved to be from 20% to 50% cleaner than present Super Visbestos.

4. On no test did either product exceed even the much more stringent TWA level to be imposed by OSHA, in 1976.

5. Based on these extensive tests under varied conditions, no special breathing apparatus would be required when running either Montello's Super Visbestos or the much cleaner New Granular form of Super Visbestos.

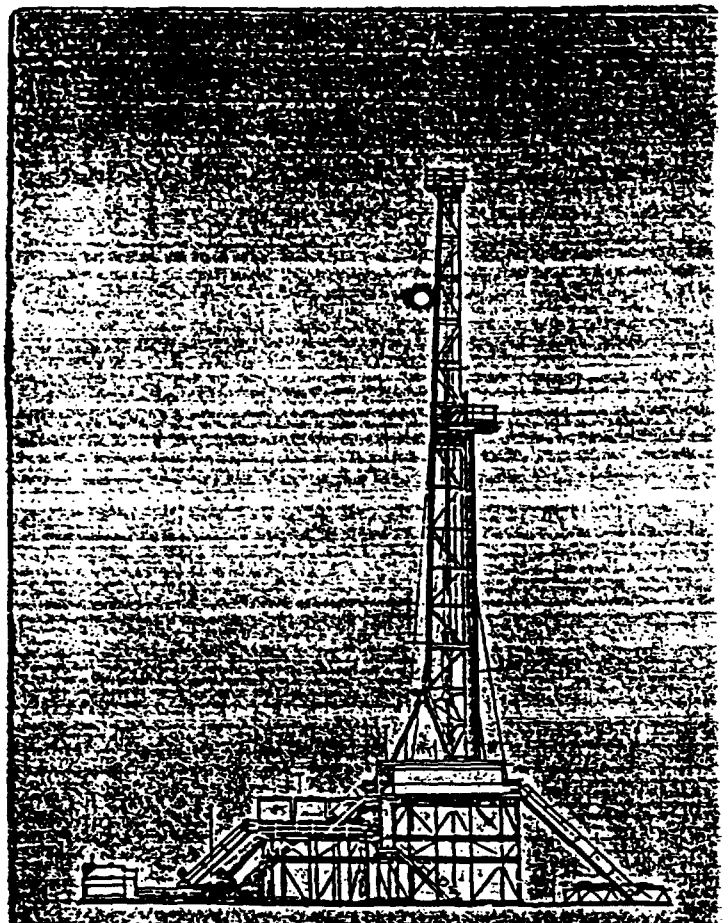
We will be pleased to discuss the attached reports with any interested parties in greater detail. Please contact our Sand Springs office if you have any questions.

Sincerely,

MONTELLO, INC.

Kenneth N. Campbell

Montello
P.O. BOX 130, SAND SPRINGS, OKLAHOMA 74063 /(918)-245-6661/TWX 910-840-3007



# Recommended Work Practices for Using Asbestos in Drilling Mud

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October 25, 1982

## Introduction

The Occupational Safety and Health Act (OSH Act) in the United States and similar laws in Canada and other countries were enacted to ensure every worker, as far as possible, a safe and healthy workplace. This legislation is far-reaching. It covers millions of employees and nearly every employer.

The information and guidance in this booklet have been developed to assist in assuring compliance with the OSHA Act and the Occupational Safety and Health Administration's (OSHA) standard for occupational exposure to asbestos dust (29 CFR Part 1910.1001). The use of good work practices is recognized as a principal means of reducing health hazards associated with exposure to asbestos dust.

OSHA acknowledged in 1975 that a need existed to regulate separately non-fixed workplaces where a highly transient workforce is employed. This is because health standards adopted for fixed-worksite jobs in manufacturing industries do not necessarily advance OSHA's worker health goals in non-fixed work operations.

This booklet contains good work practices for handling asbestos drilling mud additives. The recommendations that appear on the following pages were developed through experience, study, and field testing. They are designed to achieve safer and more healthful job site conditions when working with asbestos mud additives in the drilling industry.

The Asbestos Information Association/North America believes that this booklet will be helpful for warehousemen, engineers, superintendents, contractors, foremen, and drilling crews.

## Asbestos and Health

The health problems which are occurring today are associated primarily with excessive past occupationally-related exposure to airborne asbestos dust. However, there is no evidence of any health risk to the general public from current uses of asbestos in our society nor from ingestion of asbestos fibers, as in drinking water, beverages or food.

It should be emphasized that the evidence of adverse health effects due to the combined actions of cigarette smoking and exposure to chemical and physical agents in the workplace is well established. Workers who handle asbestos greatly reduce their health risks by not smoking cigarettes.

We will continue to see cases of asbestos-related disease for some years because of the unfortunate legacy of excessive past exposures. Current medical evidence leads to the expectation that workers exposed to current permissible levels of asbestos dust will not develop disease.

The present state of scientific knowledge shows clearly that minimizing exposure to airborne asbestos dust reduces the risks of asbestos-related disease. Good work practices are one means of significantly reducing generation of dust.

## Summary of OSHA Asbestos Standard

Under the current OSHA standard for occupational exposure to asbestos dust, it is the employer's responsibility to assure that exposure of employees to airborne concentrations of asbestos fibers does not exceed the following permissible exposure levels:

a. Eight-hour time-weighted average (TWA): Two fibers longer than 5 micrometers, per cubic centimeter.

b. Ceiling concentrations: Ten fibers, longer than 5 micrometers, per cubic centimeter (f/cc).

OSHA Instruction CPL 2-2.21A of February 18, 1981 states that medical examination requirements of the asbestos standard will be required where the 7 to 8-hour TWA fiber concentration is 0.1 f/cc or greater.



Extensive field monitoring has demonstrated that the proper use of asbestos mud additives can result in dust levels which are less than an 8-hour TWA of 0.1 f/cc. By following the work practices recommended in this booklet when using such products, dust levels can be kept consistently below this level. (Suppliers of asbestos mud additives should be contacted for monitoring data.)

## Products and Operations

These work practices apply to the use of specially processed asbestos mud additives in drilling fluids.

Operations to which these work practices apply include:

A. Shipping, Receiving, Handling, Warehousing and Storage

B. Addition to Mud System

C. Housekeeping and Waste Disposal

## Recommended Work Practices

### A. Shipping, Receiving, Handling, Warehousing and Storage

**Shipping and Receiving**

Asbestos mud additives are shipped by suppliers in loose or palletized sacks. Normally, pallets will be shrink-wrapped or stretch-wrapped.

Inspect sacks for any damage in shipment. Repair damaged sacks with heavy-duty tape or resack in sealed sift-proof bags.

**Handling, Warehousing and Storage**

Be careful to avoid rough handling of sacks. Do not store sacks or pallets to excessive height (no more than 6 feet for sacks or 3 pallets high).

Allow ample clearance between pallets and be especially careful to avoid damaging sacks when using mechanical aids such as forklifts and handcarts in storage area.

Inspect stored material frequently for damage or breakage, and make any necessary repairs promptly.

Spills should be cleaned up promptly by wetting down the spill before sweeping or handling. Put wet material in a sealed sift-proof bag. Alternately, a vacuum with a high efficiency filter can be used to clean up spills. NEVER DRY SWEEP OR BLOW ASBESTOS WITH COMPRESSED AIR.

AVOID CREATING DUST

**B. Addition to Mud System**

Stand upwind when emptying sack. A lightweight streamer should be used to determine wind direction.

Asbestos should be added directly to the mud system by emptying the sack at a uniform rate (no special equipment is required to add the asbestos).

Empty sacks should be accumulated in sift-proof bags for disposal.

AVOID CREATING DUST

**C. Housekeeping and Waste Disposal**

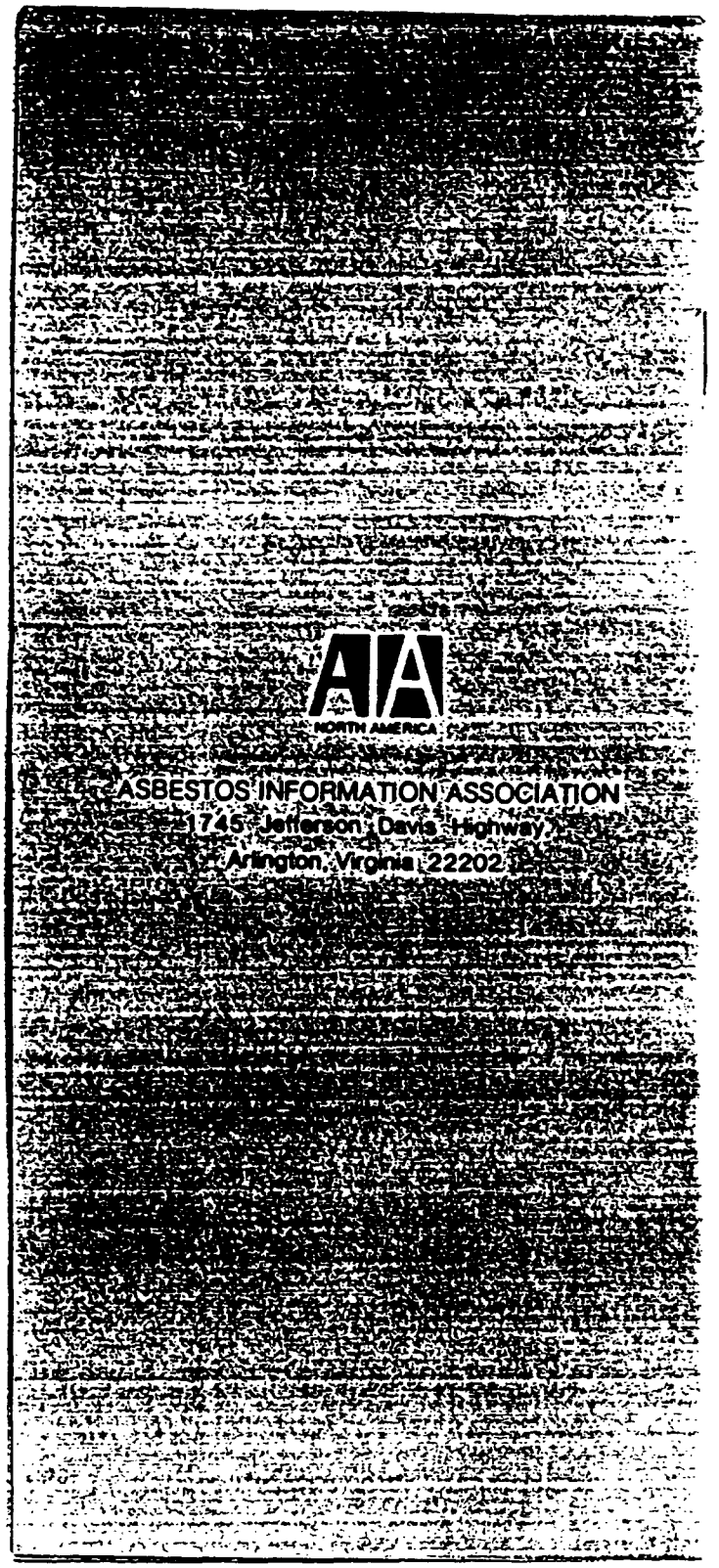
Housekeeping is an essential part of any safe operation. Airborne asbestos dust created by the lack of good housekeeping has the potential for harm to employees and others.

Keep work areas clean by hosing down or vacuuming. NEVER DRY SWEEP OR BLOW ASBESTOS WITH COMPRESSED AIR.

Dispose of empty sacks in a sift-proof bag, and remove from immediate work area for ultimate burial.

When the well is finished, there is usually little or no asbestos left in the mud. Any acceptable method of storing the mud for reuse or disposing of it can be used.

AVOID CREATING DUST


AIA
NORTH AMERICA
ASBESTOS INFORMATION ASSOCIATION
1745 Jefferson Davis Highway
Arlington, Virginia 22202

DRILLING SPECIALTIES COMPANY
BARTLESVILLE, OKLAHOMA 74003

October 4, 1972

Material Safety Data - Cellex, Drispac®, Diacel® D and Soltex®

P-1-Sh-183-72D

Mr. W. B. Kirkland
Purchasing Agent
Baroid Division
P.O. Box 1675
Houston, Texas 77001

Dear Sir:

You have asked for material safety information on the products we sell you. This is to advise you that our products Cellex (Regular, High Viscosity and Technical Grade), Drispac, Diacel D and Soltex are not hazardous as defined by the Occupational Safety and Health Act of 1970. We will be pleased to give you any non-proprietary information on these products if you still feel you need it. This information in your U. S. Department of Labor Form LSB-OOS-4 would just clutter your files with non-essential information.

The U. S. Department of Labor's "Instructions and Explanation of Terms" for LSB-OOS-4 says, "The Material Safety Data Sheet (Form LSB-OOS-4), or one essentially similar, approved by the Bureau of Labor Standards, is required to be filled out only on materials which, when used without special precautions and controls, will constitute a health hazard to workers."

We are preparing forms for you on our products Flosal®, Diaseal M® and Desco®. These will be sent to you in the near future.

Very truly yours,

F. J. Shell, Manager
Technical Services
309 Short Street
Telephone 918 661-5406

FJS:dr

Calidria ASBESTOS

UNION CARBIDE
THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION • MINING & METALS DIVISION • P.O. BOX 579 • NIAGARA FALLS, N.Y. 14302 • TEL: 716-285-3311

July 13, 1972

Mr. K. Campbell
Montello, Inc.
P.O. Box 130
Sand Springs, OK 74063

"VISBESTOS"

Dear Ken:

This is in response to the letter you received from IMC, dated 6/14/72, concerning bag labelling under OSHA regulations. The label is to read:

CAUTION
Contains Asbestos Fibers
Avoid Creating Dust
Breathing Asbestos Dust May Cause
Serious Bodily Harm

This is quoted exactly from the Federal Register so I imagine IMC just made editorial oversights in their letter.

Our bags are now identified as containing asbestos and have the following label:

WARNING: BREATHING DUST MAY BE HARMFUL
DO NOT BREATHE DUST

I met with OSHA in Washington in early June and was advised verbally that our bag markings were adequate to permit depletion of our existing stock, that we could adopt the new label on subsequent bag orders. You can pass this on to IMC and we will probably obtain a written variance from OSHA in the not-too-distant future. We are satisfied that our bag markings will satisfy OSHA requirements on an interim basis.

Best personal regards.

Very truly yours,

John L. Myers

cc: Mr. F. H. Larrison
Mr. J. W. Rawlings
Dr. H. B. Rhodes

On June 7, 1972, stringent Federal regulations went into effect on the commercial use of asbestos. The impact of these regulations on the drilling industry has been a source of concern and confusion to suppliers and users, alike.

Because of this, we at Montello determined to ascertain how our unique, wet-refined Super Visbestos would perform, in the context of the OSHA regulations, under the widely varying conditions found on drilling rigs. With the invaluable cooperation and assistance of several companies, four on-site tests and their evaluation have now been completed.

Attached is a copy of an extensive report which gives a detailed interpretation of the results from these four tests. Site selection was based on a desire to evaluate the broadest possible range of dumping environments. Three different forms of our asbestos were checked to determine the effects of fine grinding, coarse grinding (i.e. crushing) and granulating, on air entrained dust levels.

We believe interested readers will find this report informative. On the next page, we've recapped the more important points which it includes. In substance, the results lead us to believe that there is no reasonable expectation of exceeding the limit values imposed by the regulations, when using either Crushed Super Visbestos or the much cleaner New Granular Super Visbestos.

We'll be glad to answer any questions you may have. Just drop us a line or call our Sand Springs office.

Respectfully presented,

MONTELLO, INC.

Kenneth N. Campbell

KNC/jd

Montello

P.O. BOX 130, SAND SPRINGS, OKLAHOMA 74063 /(918)-245-6661/TWX 910-840-3007

A study covering airborne dust concentrations in drilling fluid operations using wet-refined asbestos has been completed. The following are some of the more important points to consider:

1. All tests were performed using Montello's exclusive wet processed asbestos products. The findings cannot be safely applied to any of the several dry ground products on the market.

2. Fiber counts were highest on fine ground material and lowest on granular material, with coarsely ground (crushed) material falling between these two.

3. Crushed Super Visbestos, which has been used in the field for several years, consistently fell well below the OSHA regulations as to maximum ceiling limit and 8 hour, time weighted average, (TWA).

4. New Granular Super Visbestos, now available in the field at no extra cost, proved to be from 20% to 50% cleaner than Crushed Super Visbestos.

5. Neither form of Super Visbestos exceeded even the much more stringent TWA level which will become effective in 1976.

6. Based on this test series, Super Visbestos in either form offers a safety margin of 5 to 1 or more, in complying with the limits set by the regulations. Therefore, we believe there is no reasonable expectation of exceeding the legal limits, when using Crushed or New Granular Super Visbestos.

# AIRBORNE ASBESTOS DUST CONCENTRATIONS

in

# DRILLING FLUID OPERATIONS

using

# WET-REFINED ASBESTOS

This report provides a general interpretation of the overall results from four on-site evaluations. Individual reports on each are available.

H. B. Rhodes

&

E. J. Kleber

PLEASE NOTE: Most of the companies co-operating in these tests are customers of Montello and conducted the tests to ascertain that their use of the product complies with standards set forth in the federal Occupational Safety and Health Act. Results of these tests are made available to other companies solely for their use in making their own evaluations of procedures to be followed in using the material. No representations are made, nor are to be implied, from this report as to the safety of this material no matter how it is used.

UNION CARBIDE CORPORATION
Mining & Metals Division
Niagara Falls, New York

February 22, 1973

## INTRODUCTION

A survey has been made to examine the levels of asbestos dust that may occur when wet-refined asbestos is used as an ingredient in drilling fluids. Both open-air and enclosed dumping operations were checked. A range of dumping rates from 10 to 80 sacks per hour was used.

Tests were run with three types of wet-refined asbestos:

1. A fine-ground hydrophobic asbestos known commercially as Arcovis 953. (2)
2. A coarse-ground asbestos known commercially as Super-Visbestos.
3. A new version of Super-Visbestos in the form of 1/8" granular pellets.

It is important to emphasize that the dust levels reported herein are specific for the wet-refined asbestos types described and do not apply to dry-processed California or Canadian asbestos.

The reports giving the details of the dumping and sampling at four locations and the raw data obtained are appended for reference. This report provides a more general interpretation of the overall results.

## SUMMARY AND CONCLUSIONS

The highest dust level measured during any of the nine dumping operations tested was 5.5 fibers/cc. greater than 5 micrometers in length(1) which is over 55% of the allowable ceiling concentration. This level occurred during the dumping of the fine-ground product in a small enclosed area to simulate North Slope conditions and is not typical of routine mud operations. The more representative tests gave results below 2 fibers/cc. which is less than 20% of allowable.

Time-weighted average values were calculated for all dumps on the basis of one dumping period per shift and a background exposure of 0.3 fiber/cc. during the time asbestos was not being handled. The highest value found in any of the dumps was 0.7 fibers/cc. for North Slope conditions with 0.3-0.4 fibers/cc. typical of normal operations. The latter values are less than 10% of the current allowable value of 5 fibers/cc. and 20% of the projected value of 2 fibers/cc. in 1976.

As would be expected, the new-granular product gave much less dust, i.e., 20-50%, than the coarse-ground Super-Visbestos.

## CALCULATION PROCEDURES

The OSHA regulations permit exposure to a ceiling concentration of 10 fibers/cc. and an 8-hour time-weighted average exposure of 5 fibers/cc. In this work, the ceiling concentration occurred in the breathing zone of the operator during the dumping of the asbestos and is reported directly as measured.

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(1) For convenience, in this discussion the term "fibers/cc." will be taken to mean the entire term, "fibers/cc. greater than 5 micrometers in length."

(2) Use of this product is covered by U.S. Patent No. 3,618,680.

The 8-hour time-weighted average is basically a simple concept that can be expressed as:

$$\text{T.W.A.} = \text{Time-Weighted Average} = \frac{\sum \left[\text{Fibers/cc. in a particular sample}\right]\left[\text{Time in hours over which the particular sample was collected}\right]}{8}$$

Where: $\sum$ = Summation of samples collected over the 8-hour period.

In order to be strictly correct, it is necessary to sample over the entire 8-hour period to define the TWA. In these tests, however, only a short post-dump sample was obtained. Normally, at a well, an operator dumps for a short period once a shift (or tour) and spends the remainder of the time out of the immediate dump area. It is thus reasonable to estimate the TWA for the operator as a combination of the ceiling concentration (measured) exposure during the dump and a background exposure for the remainder of the shift. The data obtained in this work indicate a reasonable and probably conservative (high) value for the background of 0.3 fibers/cc. This number will be used in the calculation of 8-hour TWA values.

## REVIEW OF DATA

Dust counts have been obtained at four locations; three by Union Carbide and one by [redacted] Complete reports are appended for reference.

In this section, the data are reviewed and the technical basis for the background level assumption just described is provided. An 8-hour time-weighted average value is also calculated for each dump.

### [redacted] Central Oklahoma Well Location

In this test, 20 sacks of regular Super-Visbestos were dumped over a 21-minute period. After a wait of about 10 minutes, 20 sacks of the New Granular Super-Visbestos were dumped over a 26-minute period.

The fiber count data for the airborne dust samples obtained is shown graphically in Figure 1. The figure gives fiber count as a function of elapsed time.

The ceiling concentration sample taken in the breathing zone of the operator during the dump of regular Super-Visbestos gave a count of 1.9 fibers. When granular Super-Visbestos was dumped 10 minutes later, the count was down to only 0.4 fibers. During these same periods, the downwind counts were 0.51 and 0.31 fibers, respectively, while upwind values of <0.1 and 0.15 fibers were found. The wind was a light, somewhat variable breeze so all of these values seem reasonable and internally consistent.

Note that the highest environmental sample found (Position 3, downwind) was only 0.5 fiber and this occurred during the dumping of the ground Super-Visbestos. With granular Super-Visbestos the maximum seen was 0.3 fiber or less. The assumed value of 0.3 fiber for the background level when no asbestos is being handled thus seems reasonable.

Note that both environmental samples (Positions 1 and 3) were 0.3 fiber or below during the granular Super-Visbestos dump. The assumed value of 0.3 fiber for the background level when no asbestos is being handled thus seems reasonable.

The data in Figure 1 can be used to estimate TWA values for both types of asbestos dumped. For the regular Super-Visbestos, consider the exposure to be 1.9 fibers for the 30-minute period covering both the dump and subsequent time until the lower reading was obtained. For the remaining 7-1/2 hours of the shift, it is assumed that the operator dumps no more asbestos and is exposed to a background level of 0.3 fibers.

Thus:

$$TWA = \frac{(1.9 \text{ fibers})\ (0.5 \text{ hours}) + (0.3 \text{ fibers})\ (7.5 \text{ hours})}{8 \text{ hours}}$$

$$TWA = \frac{3.21}{8} = 0.4 \text{ fibers}$$

This is only (0.4) (100)/5 = 8% of the allowable exposure level.

For the granular Super-Visbestos, consider the exposure to be 0.4 fibers for 0.5 hour and the assumed background of 0.3 fibers for 7.5 hours. Thus:

$$TWA = \frac{(0.4)\ (0.5) + (0.3)\ (7.5)}{8} = 0.3 \text{ fibers}$$

This is 6% of the allowable TWA.

[redacted] Location Near Houston, Texas

The next series of tests to be examined were run at [redacted] on September 25 and 26, 1972. These tests were intended to simulate conditions on the North Slope. Dumping was done in a small, covered enclosure about 10' x 11' x 9' high. Dumps were made with one side open 8' to approximate normal conditions and with everything closed as occurs in the Arctic during extremely cold and windy weather. Finely-ground hydrophobic asbestos (Arcovis 953) and granular Super-Visbestos were dumped on successive days.

Finely-Ground Hydrophobic Asbestos: In the first day's test, 30 sacks of Arcovis 953 were dumped in 29 minutes with the 8' door open. Dust levels were monitored during the dump and for a 1-1/2 hour period thereafter.

Approximately 2-1/2 hours later the door was closed and 30 more sacks of Arcovis were dumped in 36 minutes. Dust levels were again measured during the dump and for about 1-1/2 hours thereafter. The data are shown in Figure 2 with the airborne asbestos dust concentration in fibers/cc. greater than 5 micrometers given as a function of elapsed time.

The exact sample point locations referred to in the figure are shown in the appended report. They are approximately:

1. In a "dead" corner adjacent to the door.
2. Directly over the hopper. (The hopper is near the wall on the opposite side from the door.)
3. Breathing zone of operator during dump.
4. Over empty sacks in rear corner near hopper.

During the first dump, with the door open, the ceiling concentration sample from the operator's breathing zone gave a level of 1.3 fibers. All of the other samples were 0.3 fiber or less.

In the second dump with the room closed tightly, the breathing zone (#3) and the sample directly over the hopper were very close at 5.5 and 5.2 fibers, respectively. When the dump was finished, the level over the hopper (#2) then dropped sharply to 0.5 fiber. At the same time, the level at Point 4, near the hopper but over the empty bags was only 0.3 fiber.

In normal practice in the Arctic, the dump is made and the operator leaves the area entirely. On this basis, it would be reasonable to use a value of 0 fibers for the time outside of the dump in estimating the TWA exposure. In order to keep the data directly comparable with the other locations covered in this report, however, the value of 0.3 fiber will be used. The results in Figure 2 also corroborate that the 0.3 level for general background is probably high.

The data can be used to estimate the TWA values for both the open and closed dumps. For the open dump, consider the exposure to be 1.3 fibers for 1/2 hour and 0.3 fiber for 7-1/2 hours.

Thus:

$$TWA = \frac{(1.3)\ (0.5) + (0.3)\ (7.5)}{8} = 0.4 \text{ fiber}$$

For the closed-door dump, the values are 5.5 fibers ~2/3 hours and 0.3 fibers for the remaining 7-1/3 hours to give:

$$TWA = \frac{(5.5)\ (2/3) + (0.3)\ (7\text{-}1/3)}{8} = 0.7 \text{ fibers}$$

Granular Super-Visbestos: In the second day's test, 30 bags of granular Super-Visbestos were dumped in 29 minutes with the door opening closed off. Dust levels were monitored during the dump and for a 1-1/2 hour period thereafter. The door was then opened and 30 more bags were dumped in 30 minutes. Dust levels were again measured during the dump and for approximately 1-1/3 hours thereafter. Sample collection points were at the same locations just described. The data are shown in Figure 3 in the same coordinates as Figure 2 but at different scales.

Before examining the data, it should be recalled that on the previous day, a more dusty product, Arcovis 953, had been dumped with the building closed. Sample Point #1 gave a reading of 1.0 fibers on a sample collected during and after the Arcovis dump. (See Figure 2)

During the first Super-Visbestos dump shown in Figure 3, Point 1 gave a value of 0.8 fiber. This dropped sharply to only 0.1 fiber when the door was opened. Also, a background sample taken over the hopper before the start of this dump had a reading of 0.7 fiber. This suggests that the closed room at the start of these dumps contained a level of 0.7 - 0.8 fibers as a residual from the previous days' tests.

During the first granular Super-Visbestos dump (room closed) the ceiling concentration breathing zone sample, #3, showed a level of 1.8 fibers. At the same time, the adjacent region over the hopper, Point #2, was at essentially the same level, i.e., 1.7 fibers. When the dump was finished, the level over the hopper (Point #2) dropped to the very low value of 0.2 fiber. At Point #4, near the hopper but over the empty bags, the level was only 0.1 fiber throughout the two hours.

During the second dump, with the door open, the breathing zone (#3) and hopper (#2) samples were both only 0.4 fiber. The formerly "dead" area (#1) was 0.1 fiber throughout. The hopper (#2) dropped to 0.1 fiber after the dump was completed. The #4 position, in the corner over the bags, went up from 0.1 fiber to the still very low level of 0.3 fiber.

Recognizing the inherent inaccuracies in the dust count technique, these data obtained and those obtained with the Arcovis present an internally consistent picture. It appears that the hopper is generally acting as an aspirator and is removing dust-laden air from the immediate vicinity. Its effect does not appear to reach as far as the opposite corner of the room, Position #1, however. The modest increase in Point #4 with the door open could be due to a "dead" area developing in the corner but the data are too limited to more than speculate.

The data from Figure 3 can be used to estimate the TWA values for the operator. For the closed-door case, the peak concentration would be 1.8 fibers for 1/2 hour to give:

$$TWA = \frac{(1.8)\ (0.5) + (0.3)\ (7.5)}{8} = 0.4 \text{ fiber}$$

For the open-door dump, the values are 0.4 and 0.3, respectively, to give:

$$TWA = \frac{(0.4)\ (0.5) + (0.3)\ (7.5)}{8} = 0.3 \text{ fiber}$$

[redacted] Texas Panhandle Well Location

The third series of tests were run at [redacted] The mud was mixed in a 25' x 7' mud house with open doors at both ends. The hopper was adjacent to the door at one end of the house. A diagram is available in the complete report appended.

The test consisted of a dump of 10 bags of Super-Visbestos at regularly spaced intervals of 6 minutes over a 60-minute period. This was followed by a 30-minute wait and then a dump of 10 bags of granular Super-Visbestos in the same manner. During the entire period, the wind outside was blowing strongly. It was in a direction, however, such that even though both doors were open there was no strong draft through the building.

For these tests, samples were collected at the following points:

Position 1: Opposite corner at same end of trailer as mud hopper.

Position 2: End of trailer at opposite from the mud hopper.

Position 3: Operator breathing zone during dumps.

The dust count results obtained are shown graphically in Figure 4. For the dump of regular Super-Visbestos, the dust level in the breathing zone was 1.0 fiber. The environmental samples near the hopper and at the other end of the trailer were considerably lower and decreased with distance from the hopper.

During the following half hour (12:15-12:45), the two environmental samples showed a moderate increase which also continued over the ensuing one-hour dump of the granular Super-Visbestos. In the half hour after the second dump, however, the levels at both Position 1 and Position 2 dropped. The breathing zone sample collected during this dump was the same as the adjacent environmental sample at Position 1, i.e., 0.5 fiber.

This pattern suggests that the second breathing zone sample is more representative of the general level at the hopper end of the trailer than a direct measure of dust generation by the granular Super-Visbestos. The correct granular Super-Visbestos level, however, should be no more than the 0.5 fiber measured.

As in the previous tests, the general level of environmental samples, i.e., 0.1 - 0.3 fibers in the opposite end of the trailer, and 0.3 - 0.5 fibers directly adjacent to the dumping area, continue to support the validity of the value of 0.3 fiber as the background exposure level for the time period when asbestos is not being handled.

Regular Super-Visbestos:

$$TWA = \frac{(1.03)\ (1) + (0.3)\ (7)}{8} = 0.4 \text{ fiber}$$

Granular Super-Visbestos:

$$TWA = \frac{(0.5)\ (1) + (0.3)\ (7)}{8} = 0.3 \text{ fiber}$$

[redacted] South Louisiana Well Location

The last data to be considered were obtained by [redacted] This was an open-air dump wherein 21 bags of granular Super-Visbestos were dumped in 15 minutes and 5 minutes were spent in cleanup and disposal of the bags. A slight wind was blowing towards the worker. Two samples were collected simultaneously in the breathing zone of the worker during the dump. (1) One sample was collected at the same time in the breathing zone of an observer standing about 3' upwind. Results are shown in the table below.

| SAMPLE NO. | LOCATION | TIME MINUTES | FLOW RATE LITERS/MIN | TOTAL VOLUME LITERS | ASBESTOS CONC. FIBERS/CC. |
|---|---|---|---|---|---|
| 1 | At breathing zone of worker. | 22.0 | 1.5 | 33.0 | 1.4 |
| 2 | At breathing zone of worker. | 21.3 | 2.9 | 61.8 | 0.6 |
| 3 | At breathing zone of the observer. | 20.3 | 4.3 | 87.3 | 0.0 |



(1) During the dump, as well as during cleanup and associated operations.

The data from the two breathing zone samples, although somewhat different, are in reasonable agreement for this kind of dust sampling and counting. The levels found are also in the same general range as the results obtained at the other three locations. The zero level found for the observer also supports the assumption of the 0.3 fiber value for TWA calculations. Thus:

$$TWA = \frac{(1.4)\ (0.33) + (0.3)\ (7.67)}{8} = 0.35$$

or using the 0.6 fiber reading

$$TWA = \frac{(0.6)\ (0.33) + (0.3)\ (7.67)}{8} = 0.31$$

## DISCUSSION OF RESULTS

The data from the various tests have been assembled in Table I arranged approximately in the order of increasing dumping rate. Both ceiling concentration and estimated time-weighted-average values are included. The data are shown graphically as a function of dumping rate in Figures 5 and 6.

### Ceiling Concentration

Figure 5 gives the ceiling concentration results. The highest value observed was 5.5 fibers that occurred when the fine-ground material was dumped in a small enclosed area. Even this level, however, is only 55% of that allowable in the OSHA regulations. All of the other data regardless of asbestos-type dumping rate or type of enclosure are below 2 fibers.

Certain of the data were paired, as shown by the connecting arrows, to test the effect of a single variable. The two pairs of points connected by the solid arrows are a direct comparison between coarse-ground (regular) and granular Super-Visbestos. As would be expected, the granular form gives half as much dust or less. The other points for granular dumps in open air at higher dump rates (open squares) bear out that the granular product form gives very low-dust levels.

The two sets of points connected by the dashed arrows compare open and enclosed dumping. Again, as is reasonable, the levels were approximately four times as great for the confined areas.

### Estimate Time-Weighted Averages

Figure 6 gives the estimated TWA values for the various dumps. As noted previously, these were calculated on the basis of the observed ceiling concentration during the dump and an assumed background of 0.3 fiber over the remainder of the shift

The highest value found was only 0.7 fiber with all of the rest of the results in the 0.3 - 0.4 range. These numbers are approximately 8% of the present allowable level of 5 fibers and only 20% of the 1976 level of 2 fibers.

I Texas Panhandle
II Central Oklahoma
III Near Houston
IV Near Houston
V South Louisiana

TABLE I

AIRBORNE ASBESTOS DUST CONCENTRATIONS
IN
DRILLING FLUID OPERATIONS

| | LOCATION | SUPER-VISBESTOS PRODUCT | CONDITIONS | DUMPING | | | DUST LEVEL(1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ceiling Concentration | | Time-Weighted Ave. (TWA)(2) | |
| | | | | Sacks | Min. | Rate (Sacks/Min.) | Fibers/cc.(3) | % of Allowable(4) | Fibers/cc.(3) | % of Allowable(5) |
| I | [redacted] | Coarse-Ground (Regular) | 7'x25' Mud House. Open door at both ends | 10 | 59 | 0.17 | 1.0 | 10 | 0.4 | 8 |
| | [redacted] | Granular | 7'x25' Mud House. Open door at both ends | 10 | 59 | 0.17 | 0.5 | 5 | 0.3 | 6 |
| II | [redacted] | Coarse-Ground (Regular) | Open air Light breeze | 20 | 21 | 0.95 | 1.9 | 19 | 0.4 | 8 |
| | [redacted] | Granular | Open air Light breeze | 20 | 26 | 0.77 | 0.4 | 4 | 0.3 | 6 |
| III | [redacted] | Fine-Ground (Hydrophobic) | 10'x11' Room Totally enclosed | 30 | 36 | 0.83 | 5.5 | 55 | 0.7 | 14 |
| | [redacted] | Fine-Ground (Hydrophobic) | 10'x11' Room 1 side open, 8' | 30 | 29 | 1.03 | 1.3 | 13 | 0.4 | 8 |
| IV | [redacted] | Granular | 10'x11' Room Totally enclosed | 30 | 29 | 1.03 | 1.8 | 18 | 0.4 | 8 |
| | [redacted] | Granular | 10'x11' Room 1 side open, 8' | 30 | 30 | 1.00 | 0.4 | 4 | 0.3 | 6 |
| V | [redacted] | Granular | Open air Slight breeze | 21 | 15 | 1.40 | 1.4(6)<br>0.6(6) | 14<br>6 | 0.3<br>0.3 | 6 |

(1) Sampling and dust counting carried out in accordance with OSHA Regulation 1910.93a.
(2) Calculated at a background exposure of 0.3 fiber/cc. for all time except during actual dumping. One dump per 8-hour shift.
(3) Fibers/cc. greater than 5 micrometers in length.
(4) Allowable = 10 fibers/cc. greater than 5 micrometers.
(5) Allowable = 5 fibers/cc. greater than 5 micrometers.
(6) Operator wore 2 samplers.

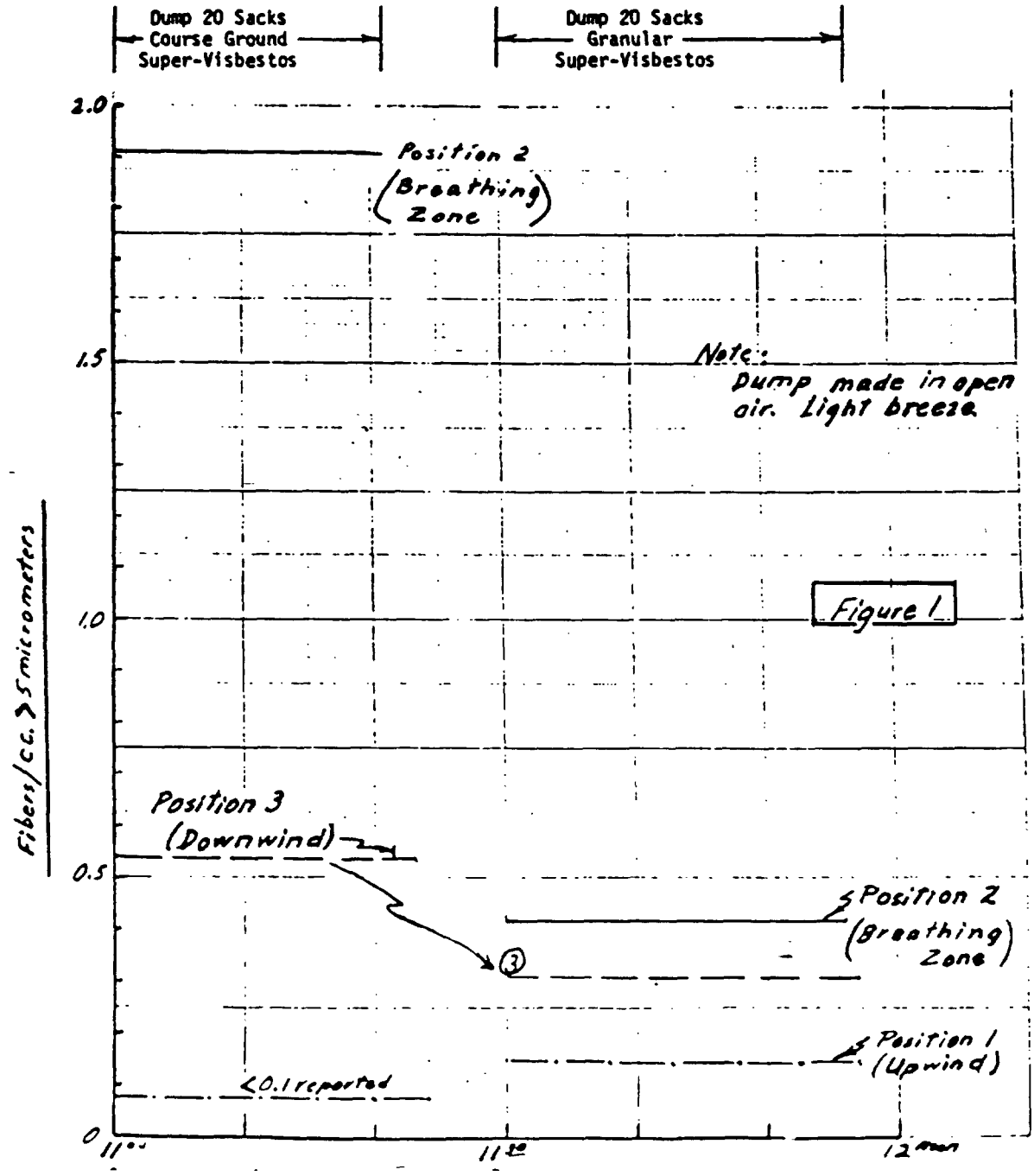
ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Central Oklahoma Well Location

[redacted]

September 27, 1972

COURSE GROUND (REGULAR) AND GRANULAR SUPER-VISBESTOS



ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Location Near Houston, Texas

[redacted]

September 25, 1972

FINE GROUND HYDROPHOBIC ASBESTOS (ARCOVIS 953)

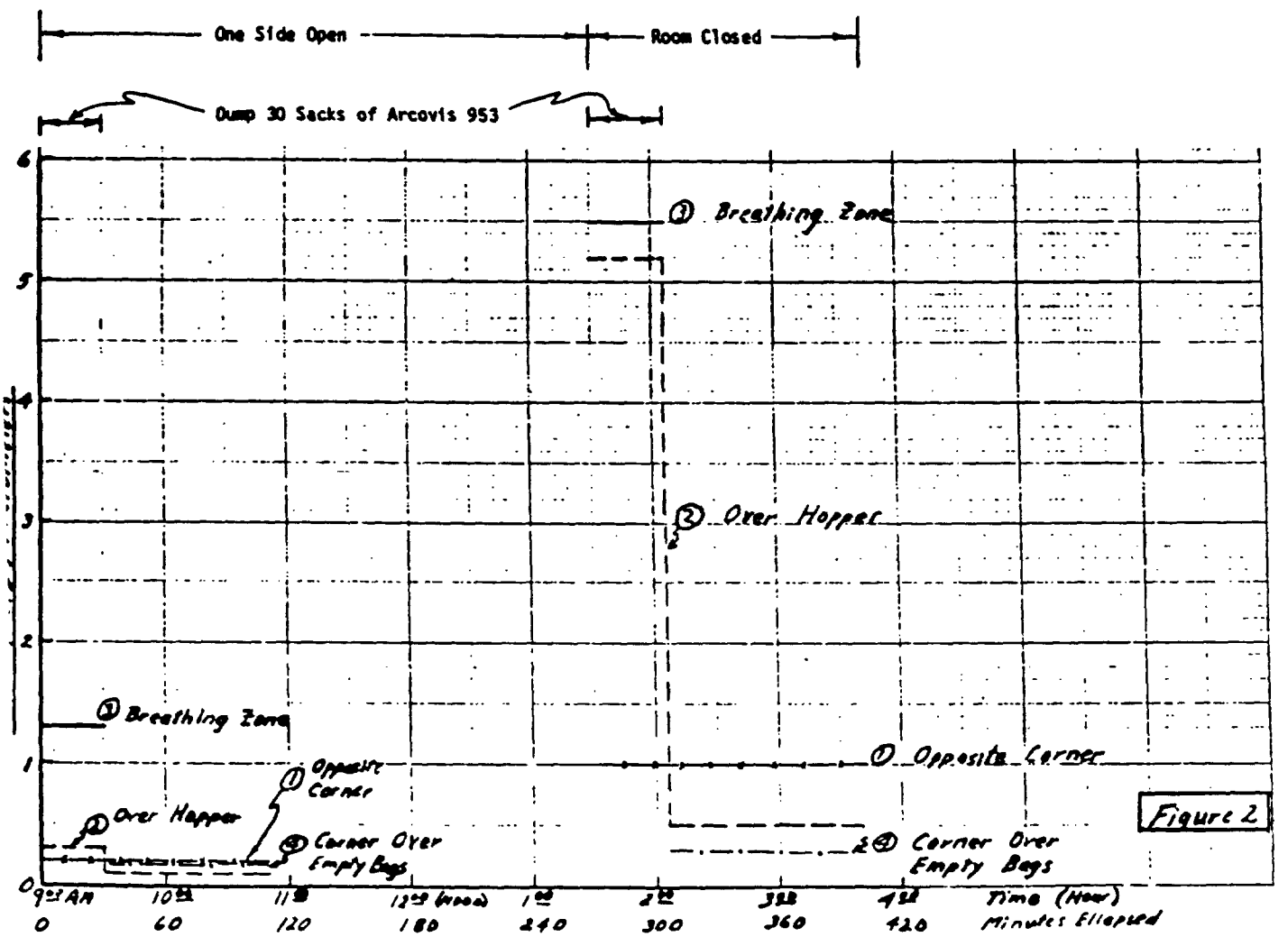



Figure 2

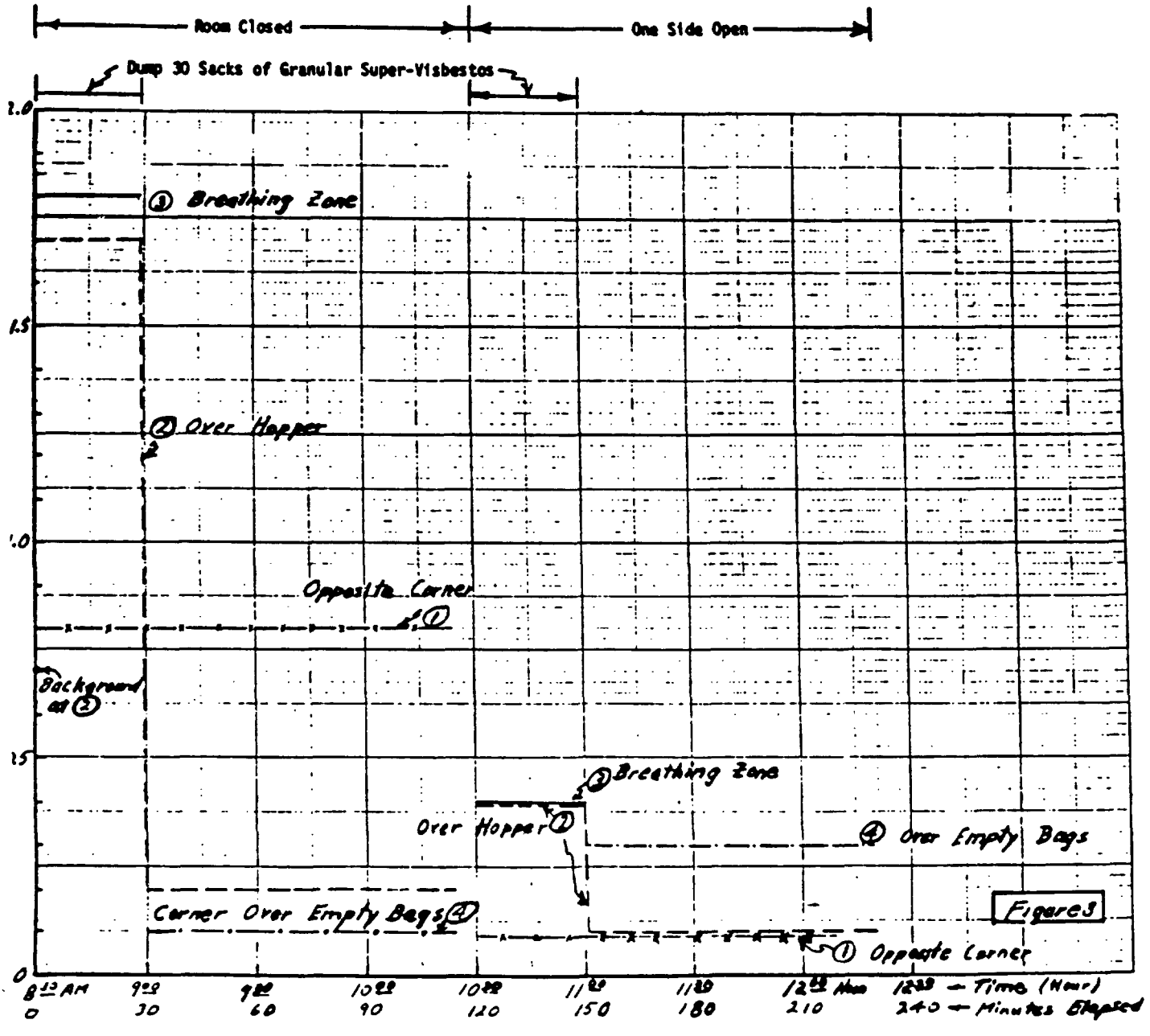
ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Location Near Houston, Texas

[redacted]

September 26, 1972

GRANULAR SUPER-VISBESTOS



ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Texas Panhandle Well Location

[redacted]

September 28, 1972

COARSE GROUND (REGULAR) AND GRANULAR SUPER-VISBESTOS

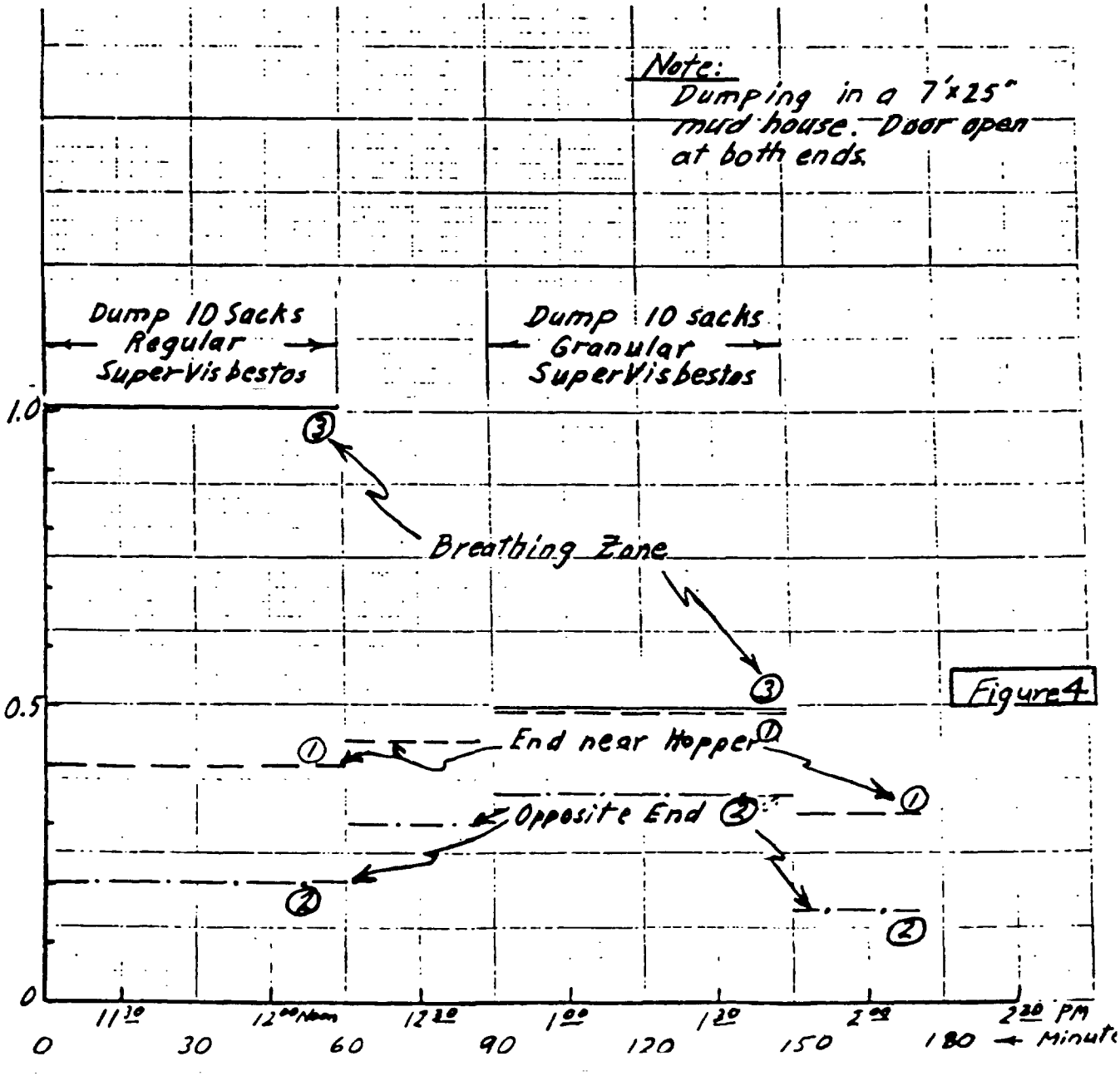



Figure 4

ASBESTOS DUST CEILING CONCENTRATIONS

DRILLING MUD OPERATIONS

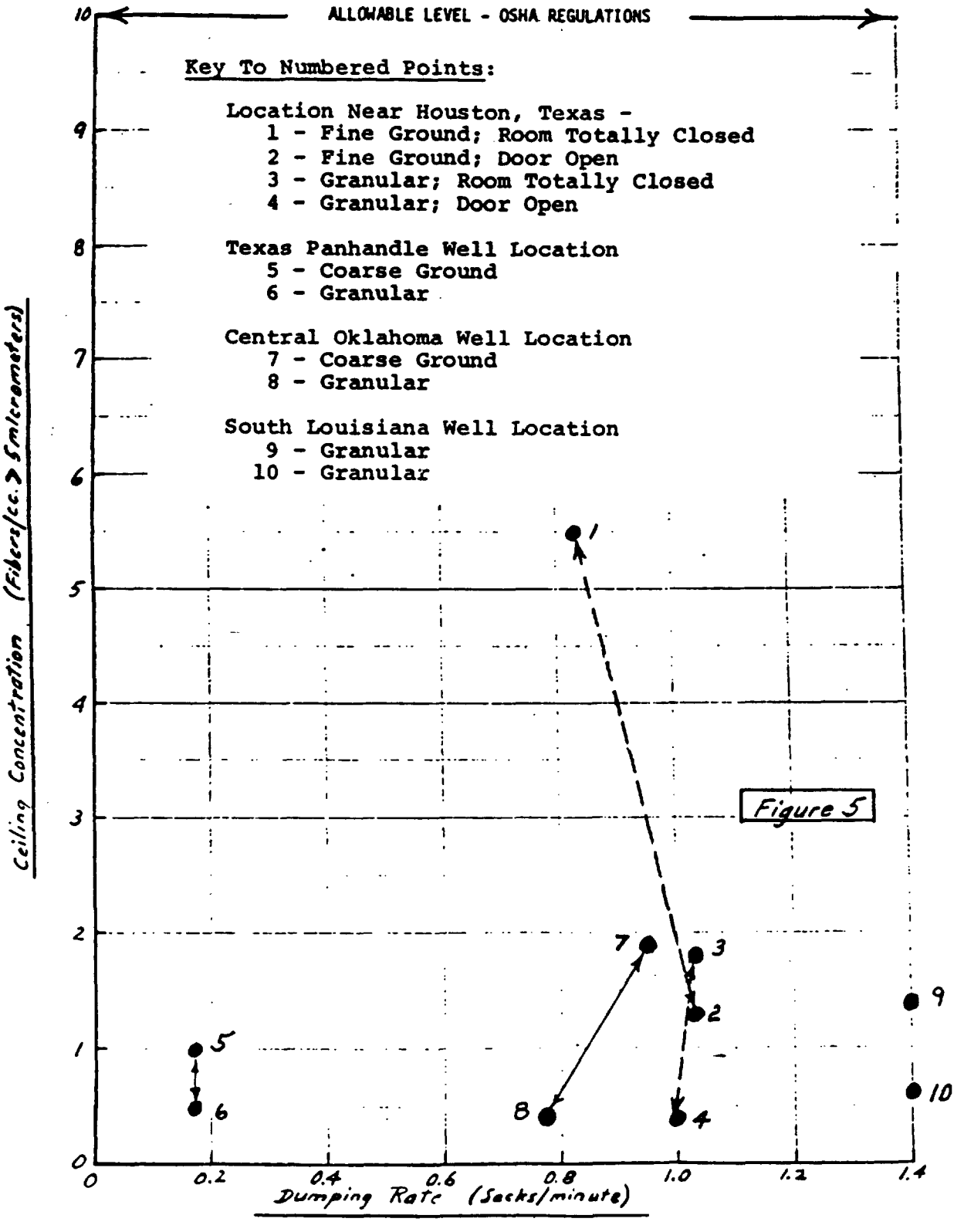



Figure 5

ASBESTOS DUST

ESTIMATED TIME-WEIGHTED AVERAGE CONCENTRATIONS

Key To Numbered Points:

Location Near Houston, Texas -
1 - Fine Ground; Room Totally Closed
2 - Fine Ground; Door Open
3 - Granular; Room Totally Closed
4 - Granular; Door Open

Texas Panhandle Well Location
5 - Coarse Ground
6 - Granular

Central Oklahoma Well Location
7 - Coarse Ground
8 - Granular

South Louisiana Well Location
9 - Granular
10 - Granular

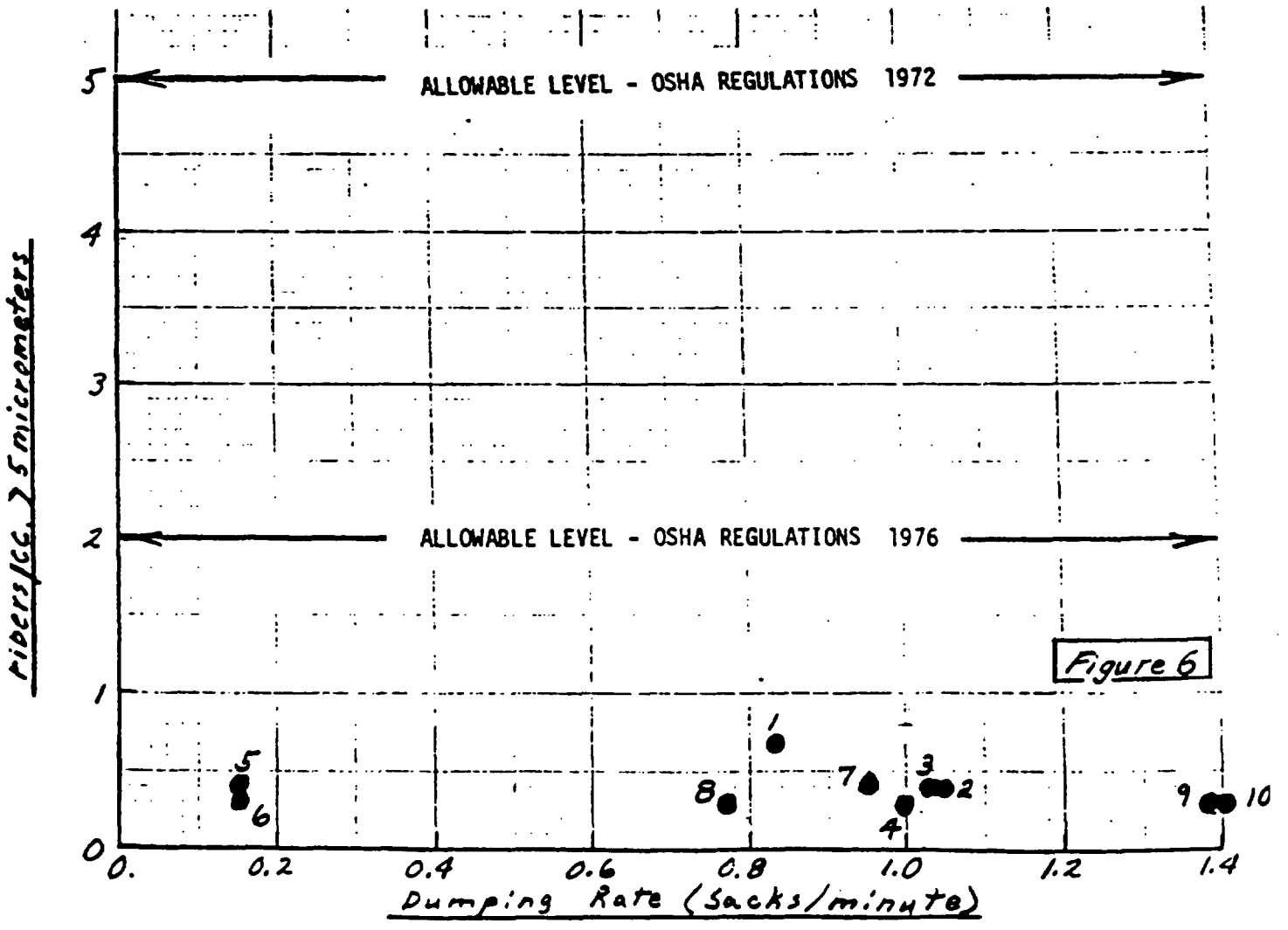



Figure 6

Montello
6106 EAST 32ND PLACE
TULSA, OKLAHOMA 74135
(918) 665-1170 / TWX 910-845-2396

March 29, 1979

Mr. W. B. Kirkland
Baroid Petroleum Services Div.
NL Industries, Inc.
P. O. Box 1675
Houston, Texas 77001

Dear Mr. Kirkland: (Pardon the formality, Wilbur!)

We have received an updated report from Union Carbide on the proposed DOT asbestos regulations. Copies of relevant information are enclosed for your use.

Union Carbide will be keeping us informed as the issue develops, and of course we'll be doing the same with you.

Best personal regards,

MONTELLO, INC.

Kenneth N. Campbell

KNC:kb

Enclosure

Caldie ASBESTOS
UNION CARBIDE CORPORATION · METALS DIVISION · P. O. BOX 579 · NIAGARA FALLS, N.Y. 14302 · TEL: 716-278 3376

March 7, 1979

Mr. K. N. Campbell
Montello, Inc.
6106 East 32nd Place
Tulsa, OK 74135

Dear Ken:

Enclosed is a copy of our petition to DOT concerning Docket No. HM-160.

Apparently, the DOT has become aware that the "entire asbestos industry" is not comfortable with dust and sift proof (not knowing what it means) and plan to make some concessions. We expect some decision by the DOT before March 31, 1979, that will probably include a waiver of the dust and sift proof requirement for a period long enough for all manufacturers to achieve compliance.

We also feel that the DOT will permit the practice of loading loose bags in closed vehicles and railcars.

Since we currently shrink-film all bags of asbestos products supplied to you, we do not plan any other changes until we get some additional word from the DOT. We have the capacity to continue to shrink-film all your products.

If it becomes necessary "at the last minute" to use the "ASBESTOS-ORM-C" designation on each bag, we will provide you with sufficient self-stick labels for inventories maintained by you and your customers.

We will keep you immediately advised of any activities concerning HM-160.

Very truly yours,

John L. Myers

John L. Myers
Marketing Manager

JLM:dal

CC: Mr. J. E. Walsh

UNION CARBIDE CORPORATION
CORPORATE DISTRIBUTION
270 PARK AVENUE, NEW YORK, N. Y. 10017

February 6, 1979

Director, Materials Transportation Bureau
Research & Special Programs Administration
U.S. Department of Transportation
Trans Point Building
2100 2nd Street SW
Washington, DC 20590

Subject: Petition For Reconsideration of Docket No. HM-160

Gentlemen:

In accordance with requirements set forth in 49CFR 106.35 enclosed herewith is the original and nine copies of Union Carbide's Petition For Reconsideration of Docket No. HM-160. This will replace a XEROX facsmile copy of Union Carbide's petition which was hand-delivered to Ms. Louise Mills of your office on February 5, 1979.

Respectfully submitted,

W. G. Kahler

W.G. Kahler II
Administrator
Hazardous Materials Transportation Regulatic

WGK:os
Enclosures

bcc: T.R. Alexander
R.F.X. Fusaro
S. Hoffman
✓ J.L. Myers
H.B. Rhodes
E.W. Shortridge
J.J. Sibley

Before The

UNITED STATES

DEPARTMENT OF TRANSPORTATION

Research and Special Programs Administration
Materials Transportation Bureau

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Docket No. HM-160

Transportation of Asbestos

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# PETITION FOR RECONSIDERATION

# SUBMITTED BY UNION CARBIDE CORPORATION

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By Notice of Proposed Rulemaking published in the Federal Register of March 2, 1978 (43 F.R. 8562) the Materials Transportation Bureau (hereinafter, "MTB") proposed certain new regulations to govern the transportation of asbestos. On December 4, 1978, final rules were published in the Federal Register (43 F.R. 56664).

Because the final rules, in some respects, differ substantially from those initially proposed, Union Carbide Corporation (hereinafter, "Union Carbide") requested, by wire dated December 27, 1978, an extension of the period within which to file a petition for recon-

sideration, and the said period was extended to February 5, 1979.

Union Carbide is engaged, among other things, in the production, sale and distribution of chrysotile asbestos and ships an aggregate of over 30,000 tons per year of such material, in pellet and fiber forms, in freight containers (for export or domestic intercoastal shipments), railroad hopper cars, rail box cars, and both open and closed motor vehicles.

Section 173.1090(d) of the final rules would permit the shipment and transportation of "commercial asbestos" (as defined) only in (i) rigid airtight packagings, and (ii) subject to other limitations hereinafter discussed, in "dust and sift proof" bags and other non-rigid packagings. As written, the final rules present several problems in connection with Union Carbide's operations, each of which is separately discussed below:

Rigid Packagings: Hopper Cars

Union Carbide currently ships substantial quantities of asbestos, in pellet form, in bulk in covered railroad hopper cars. It clearly appears that such cars qualify as both rigid and airtight and, therefore, that the final rules present no impediment to the continuation of such shipments. It is questionable, however, whether or not the term "packaging", as defined at 49 CFR 171.8,

includes railroad hopper cars. To remove any doubt in that regard, it is respectfully suggested that the final rules be amended by specifically providing that shipments of asbestos may be made and transported in covered railroad hopper cars.

Freight Containers

A similar problem is presented in connection with the movement of asbestos in freight containers, which are expressly excluded from the definition of "packaging" referred to above. Since Union Carbide also ships a substantial volume of asbestos in such containers for land-bridge or overseas delivery or via domestic water carriers, it is equally essential to Union Carbide's asbestos business that such shipments be permitted to continue. Accordingly, it is respectfully requested that the final rules be amended by specifically providing that for the purposes of § 173.1090(d) freight containers be treated as "packagings".

Non-rigid Packagings

Section 173.1090(c)(2) of the rules initially proposed in this proceeding would have permitted transportation in bags "when in closed freight containers, motor vehicles, or rail cars, that are loaded by the consignor and unloaded by the consignee". Section 173.1090(d)( of the final rules, however, deleted the said requirement and substituted therefor a requirement for dust and sift proof non-rigid

packagings and a requirement (except via private motor carriage) for palletizing and unitizing such non-rigid packagings.

Thus, provided only that the packagings are dust and sift-proof as well as palletized and unitized, the final rules would accommodate and allow shipment in open vehicles and without regard to the persons loading and unloading such vehicles. It is understandable, therefore, that the MTB concluded, as stated at 43 F.R. 56666 (center column), that new paragraph (d)(2) "recognizes less restrictive handling of bagged asbestos than was proposed".

No exception is here taken to the newly introduced requirement that bags and other non-rigid packagings be "dust and sift proof" (although, as hereinafter discussed, a definition of that term should be provided). The introduction of that requirement, however, suggests that the final rules, albeit in some respects "less restrictive" than initially proposed, are in other respects more restrictive than required. The initial rules proposed to require consignor-loading and consignee-unloading but since, under the final rules, such packagings must in the first instance be protected in some manner against the escape of asbestos dust, it is difficult to appreciate the need for such requirements. It is equal difficult to understand why the final rules require that shipments c such packagings in closed vehicles must be palletized and unitized.

Accordingly, it is requested that consideration be given to pe mitting the shipment and transportation of dust and sift proof pack-

agings in closed containers, vehicles and cars, without palletizing or other restriction.

If, however, the Bureau finds reason to impose either or both restrictions, it is respectfully suggested that all or a portion of the method initially proposed to be required (ie., in closed containers, vehicles and cars with [or without] consignor loading and unloading) should be allowed as an alternative method of shipment since, as the Bureau has recognized, such alternative would be more restrictive than the final rule embodied in § 173.1090(d)

Small Quantities

Even if the Bureau decides to delete the requirement for palletizing and unitizing non-rigid packagings, a distinct problem would remain with respect to the prohibition of shipments in quantities of less than 2000 pounds in open vehicles. First, it should be noted that such quantities cannot be economically or feasibly palletized or re-palletized by distributors selling in less-than-pallet quantities in certain applications such as oil-well drilling. Additionally, for movements of such small quantities, it would appear to be unnecessary to palletize dust and sift proof packagings, even when such packagings are loaded aboard open vehicles customarily used for pick-ups by customers in the oil-well and other businesses, s long as adequate protection (as, for example, sufficient bracing or covering of the packagings) is afforded in transit.

It is respectfully suggested, therefore, that quantities of less than 2000 pounds, net weight, per vehicle, be exempted from the palletizing and unitizing requirement; provided, however, that such exemption does not preclude the transportation of other quantities of palletized material on the same vehicle at the same time.

Unitizing Methods

The final rules require unitizing by "methods such as" shrink-wrapping in plastic film or wrapping in fiberboard secured by strapping. It appears that the primary function of unitizing the dust and sift free packagings is to lend strength to the load during transportation. An alternative and frequently more desirable method to achieve the same objective would be to glue the bags in an interlocking pattern on the pallet. To the extent that the palletizing and unitizing requirement is retained, it is suggested that the final rules be amended by including among the permitted devices "methods such as" gluing in an interlocking pattern.

Dust and Sift-Proof; Definition

Although the term "dust and sift proof" is manifestly critical to proper and uniform implementation of the new regulations, there appears to be no commonly accepted or clearly understood definition of the term. Moreover, any effort to establish a numerical criterion would be difficult and could result in complex and expensive monitor-

ing and administrative problems of enforcement. Rather than leaving interpretation to the varying criteria of individual shippers and carriers or to the arbitrary determination of individual enforcement personnel, some practical and easily applied definition should be incorporated in the new regulations. The following definition, therefore, is suggested for consideration:

> The term "dust and sift proof", as used in this section, means there is no visible leakage of asbestos from the packaging under conditions normally incident to transportation.

Effective Date

The effective date of the new regulation is April 30, 1979, and no objection thereto is here registered with respect to asbestos packaged at or shipped from the point of processing on that date or thereafter. With respect to packages in the possession of warehousemen or distributors, however, the said date would impose considerable hardship because (i) it is unlikely that all such inventory could be effectively released from such possession and shipped before April 30, 1979, and (ii) most, if not all, such warehousemen and distributors do not have adequate facilities to palletize and unitize in accordance with the final rules or to disass existing inventories of shrink-wrapped pallets, apply the newly required ORM-C marking to each bag, and repalletize and unitize such bags.

Barring currently unforeseen circumstances, it appears likely that such inventory could be disposed of in reasonably orderly fashion on or before the end of the current year. Ac-

cordingly, it is suggested that until that date the new regulations should not be effective with respect to shipments of asbestos made from origins other than processing facilities.

Conclusion

In view of the foregoing, Union Carbide respectfully requests reconsideration of the final rules as published on December 4, 1978 and, upon reconsideration, that the said rules be revised and amended as hereinabove suggested and that this Petition be otherwise favorably considered.

Respectfully submitted,

UNION CARBIDE CORPORATION

By: William G. Kahler

William G. Kahler II
Administrator
Hazardous Materials Transportation Regulatio
Corporate Distribution Department

270 Park Avenue
New York, N.Y. 10017
February 5, 1979