PLAINTIFF'S EXHIBIT
CHV-625
6-15-72

PROCEDURE FOR COUNTING ASBESTOS FIBERS COLLECTED ON MEMBRANE FILTERS(1)

The sample should be collected on a 37 mm Millipore type AA filter mounted in an open-face filter holders.(1) To prepare a sample for microscopic examination, a drop of the mounting medium is placed on a freshly cleaned, standard (25 mm x 75 mm), microscope slide. The mounting medium used in this method is prepared by dissolving 0.05 g of the membrane filter per ml of 1:1 solution of dimethyl phthalate and diethyl oxalate. The index of refraction of the medium is 1.47, slightly below that of the asbestos fibers. A wedge-shaped piece with an arc length of about 1 cm is excised from the filter with a scalpel and forceps and placed dust-side-up on the drop of mounting solution. A No. 1 1/2 coverslip, carefully cleaned with lens tissue, is placed over the filter wedge. Slight pressure on the coverslip achieves contact between it and the mounting medium. The sample may be examined as soon as the mount is transparent. The optical homogeneity of the resulting mount is nearly perfect, with only a slight background granularity under phase contrast, which disappears within one day. The sample should be counted within two days after mounting.

The filter samples mounted in the manner previously described are evaluated in terms of the concentration of asbestos fibers greater than 5 μm in length. A microscope equipped with phase-contrast optics and a 4-mm "high-dry" achromatic objective is suitable for this determination. The illumination for this system should be a ribbon filament illuminator adjusted to Kohler illumination and a green filter with a neutral density of 0.9. 10X eyepieces, one of which contains a Porton or other suitable reticle at the level of the field-limiting diaphragm, should be used giving a total magnification of about 430X. The left half of the Porton reticle field serves to define the counting area of the field. For each field focus from the surface of the filter upward to the cover glass and count all fibers which are observed in the counting area. Any particle having a length to diameter ratio of three or greater and a length greater than 5 μm is considered as a fiber. The average diameters are used when estimating the fiber diameters. Figures 1 through 4 illustrate the rules for counting fibers touching the sides of the Porton field and each other. The portions of the filters shall be

examined in a "radial" manner starting at the center and moving along a radius bisecting the portion to the arc. In addition the consecutive full fields shall be tangent to each other. A minimum of either 100 Portion fields or 300 particles is required. After reaching the arc, one should measure additional fields by following a radius which bisects the previous path and one of the edges.

After counting has been completed, the following formula is used to compute the concentration in fibers/cc:

$$\text{Fibers/cc} = \frac{A_f N}{A_p n V}$$

where A_f = area of collection surface of filter in mm^2.
A_p = counting area of a Porton field in mm^2.
N = number of fibers counted.
n = number of Porton fields counted.
V = volume of air sampled in cc.

The new standard for exposure to asbestos dust (29CRF 1910.93a) published in the Federal Register, Vol. 37, No. 110, pages 11320 and 11321, June 7, 1972, is partially quoted as follows:

§ 1910.93a Asbestos.

(a) *Definitions.* For the purpose of this section, (1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.

(b) *Permissible exposure to airborne concentrations of asbestos fibers*—(1) *Standard effective July 7, 1972.* The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(2) *Ceiling concentration.* No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(e) *Method of measurement.* All determinations of airborne concentrations of asbestos fibers shall be made by the membrane filter method at 430–450 × (magnification) (4 millimeter objective) with phase contrast illumination.

REFERENCES

1. Occupational Exposure to Asbestos-Criteria for a Recommended Standard, National Institute for Occupational Safety and Health, Health Services and Mental Health Administration, U. S. Department of Health, Education and Welfare, 1972.

*These ground rules are based on those followed for several years by personnel at the School of Public Health, University of California at Berkeley.

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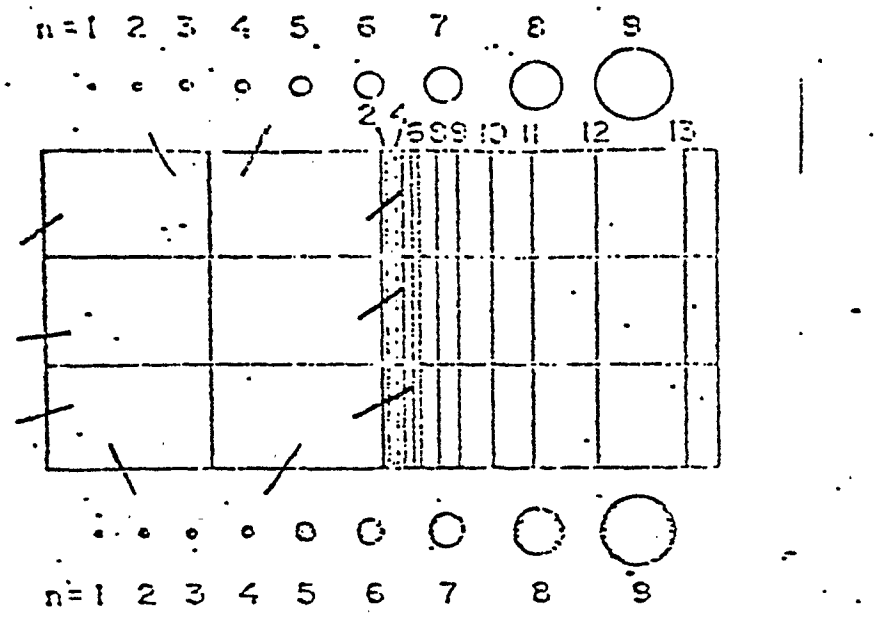

FIGURE 1 Fibers shown in green which intersect the top and left lines of the counting field are counted while fibers shown in red which intersect the bottom and right lines are not counted.

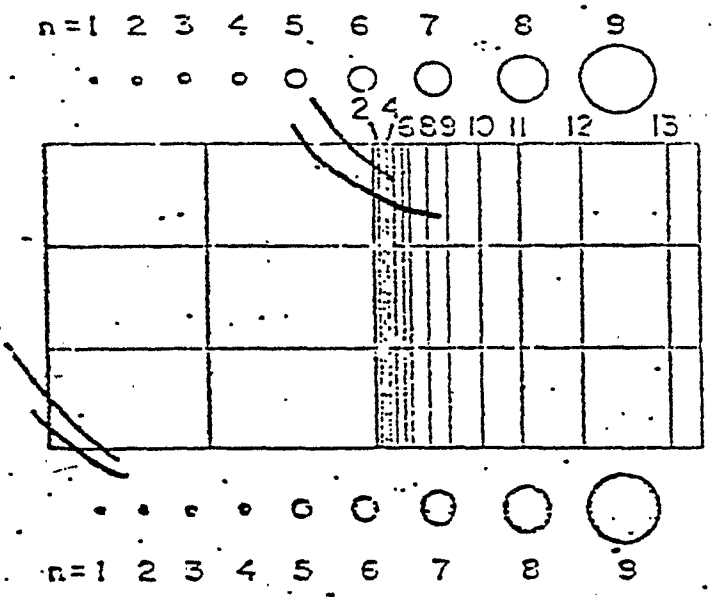

FIGURE 2 Fibers shown in green which are more outside the top or left lines than the bottom or right lines are counted. Fibers shown in red which are more outside the bottom or right lines than the top or left lines are not counted.

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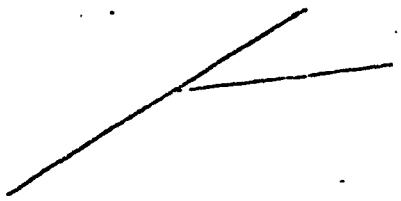

FIGURE 3 Fibers which appear to intersect but do not cross each other are counted as a single fiber as illustrated above.

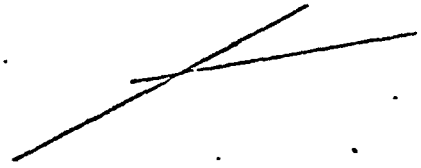

FIGURE 4 Fibers which intersect and cross each other are counted as two fibers as shown above.