NISTIR 5350

Airborne Asbestos Method: Standard Test Method for High Precision Counting of Asbestos Collected on Filters - Version 1.0

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U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary

TECHNOLOGY ADMINISTRATION
Mary L. Good, Under Secretary for Technology

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
Arati Prabhakar, Director

Preface

This Interagency Report (IR) is one of a series of IRs that will form the basis of a method for analysis of airborne asbestos by transmission electron microscopy. The form and style of the American Society for Testing and Materials (ASTM) was adopted as a standard format for this series of reports.

1. Scope

1.1 This test method provides a procedure for high-precision counting of the number of asbestos-containing particles collected onto filters.

1.2 For this method, all qualifying particles are counted as one structure; the number of asbestos fibrils within a particle does not affect the number of structures assigned to the particle.

2. Referenced Documents

2.1 *ISO Standard:*

ISO 5725 Precision of test methods - Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests

3. Terminology

3.1 *Description of Terms Specific to This Standard:*

3.1.1 *counting rules*--rules used to determine the number of structures present in an asbestos-containing particle.

3.1.2 *fibril length*--longest dimension parallel to the fibril axis.

3.1.3 *fibril width*--largest dimension perpendicular to the fibril axis.

3.1.4 *aspect ratio*--ratio of length to width.

3.1.5 *fibril*--single crystal of a regulated (asbestos) mineral with substantially parallel sides that has an aspect ratio greater than or equal to 5:1. There are no length restrictions.

3.1.6 *interconnecting*--crossing or touching

3.1.7 *particle*--an isolated collection of material deposited on a grid or filter. The carbon substrate and sample preparation artifacts must be ignored in identifying a particle.

3.1.8 *structure*--a fibril or particle containing a fibril that satisfies the one of the criteria given in items 5.1.1-5.1.3 of the procedure.

4. Significance and Use

4.1 The method provides a procedure for counting structures. The significance of the counts is not given in the method; the significance must be obtained from government agencies such as the Environmental Protection Agency (EPA) that regulate the amount of allowable asbestos.

4.2 The high precision of this method makes it appropriate for interlaboratory studies, proficiency testing, regulatory methods, or any case where interpretation of the number of asbestos fibrils in asbestos-containing particles is expected to have significant variation.

5. Procedure

5.1 The following counting rules are used to determine if an asbestos-containing particle is counted as a structure:

5.1.1 A single fibril is counted as one structure if the visible length of the fibril is greater than or equal to 0.5 µm.

5.1.2 Interconnecting fibrils are counted as one structure if the largest dimension is greater than or equal to 0.5 µm. One method of determining if this criterion is fulfilled is to place the interconnected fibrils inside a circle 0.5 µm in diameter. If the fibrils touch or exceed the circumference of the circle no matter where the interconnecting fibrils are placed in the circle, the particle counts as a structure.

5.1.3 Particles containing fibrils and nonasbestos materials are counted as one structure if either of the following conditions are satisfied:

1) part of a fibril or interconnecting fibrils protrude by at least 0.5 µm from the nonasbestos material or
2) at least 0.5 µm of one side of a fibril is visible and that side is not touching nonasbestos material.

5.1.4 For examples of application of the counting rules, see Figs. X1.1-X1.4.

6. Precision and Bias

6.1 To determine the precision of the method, an interlaboratory study of 24 laboratories involved in asbestos analysis was conducted in 1991. The laboratories were sent identical images and sketches of asbestos-containing particles and asked to report the number of structures present using these counting rules. The mean count was 37.9 structures with an estimated standard deviation of 1.6 structures (outlier results from one laboratory were discarded). The coefficient of variation in the number of structures reported by the laboratories was 0.04.

6.2 The reproducibility, the range in which 95% of the difference between any two laboratories will lie (defined in ISO 5725 as 2.8 times the standard deviation), is estimated to be 4.5 structures for this data set .

NOTE 1-- The structures analyzed in this study were complex and therefore the coefficient of variation and the reproducibility discussed above likely represent an upper bound for the imprecision of the method.

6.3 The procedure in this test method for counting of asbestos collected onto filters has no bias because the value for the number of asbestos structures is defined only in terms of this test method.

APPENDIX

(Nonmandatory Information)

X1. APPLICATION OF THE COUNTING RULES

(Note: The circles shown on selected figures in the Appendix are 0.5 µm in diameter. This scale applies to all the figures in this Appendix. All fibrous material in the figures corresponds to regulated asbestos minerals.)

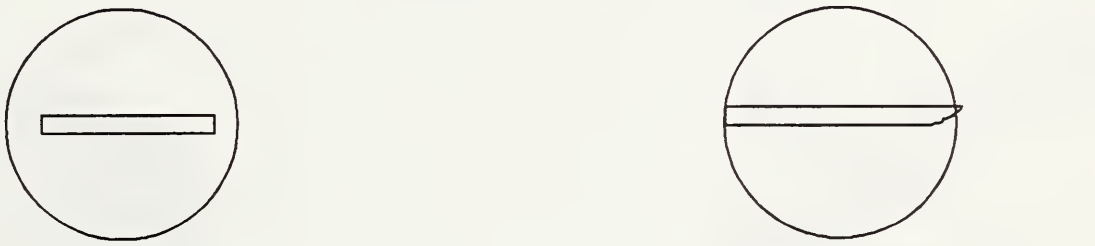


FIG X1.1 Single fibrils (item 5.1.1): a) the fibril is less than 0.5 µm in length and therefore is not counted as a structure; b) the fibril has an irregular termination - the longest dimension parallel to the fibril axis is greater than 0.5 µm and therefore the fibril counts as one structure (item 3.1.2).

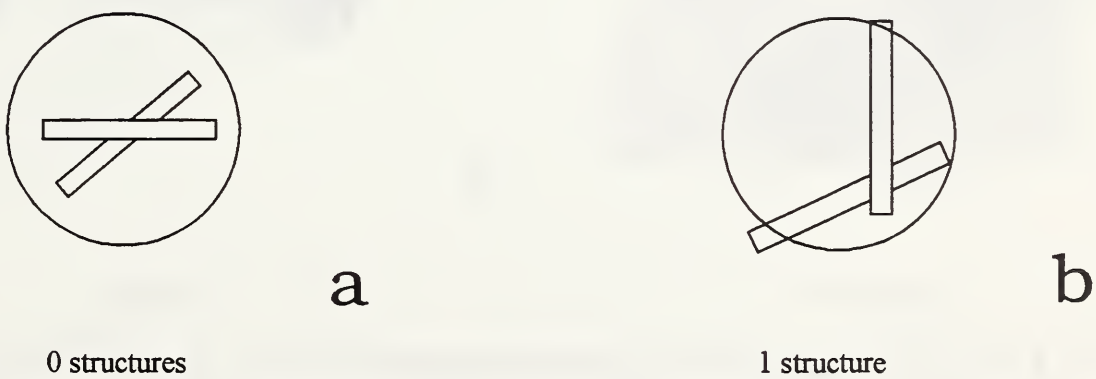
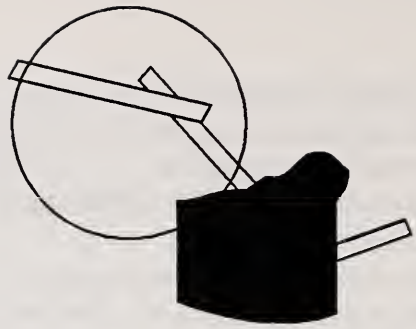


FIG. X1.2 Interconnecting fibrils (item 5.1.2): a) the largest dimension of the particle is less than 0.5 µm and therefore the particle is not counted as a structure; b) the largest dimension of the interconnecting fibrils is greater than 0.5 µm and therefore the particle counts as one structure.

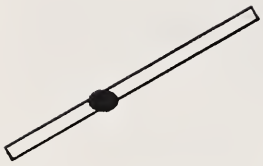
a

0 structures



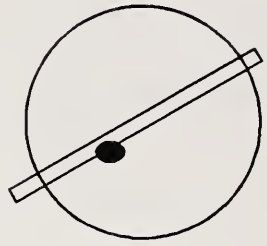
b

1 structure



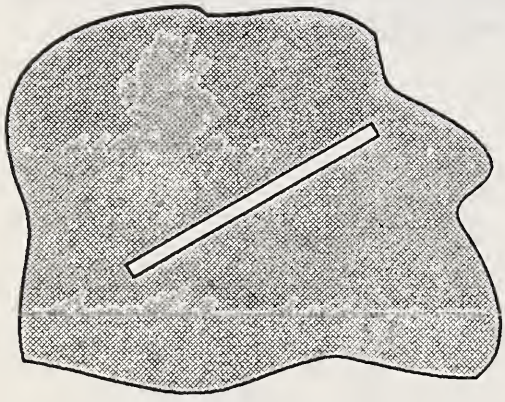
c

0 structures



d

1 structure



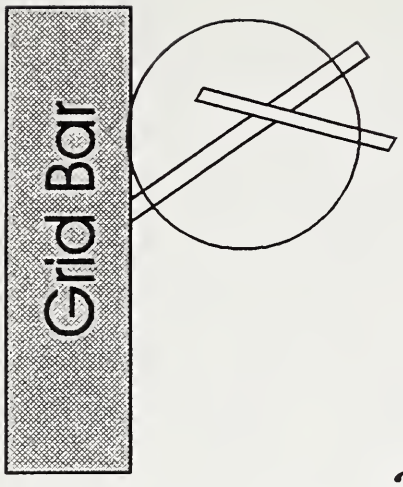
e

0 structures

f

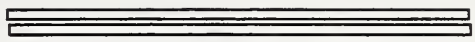
1 structure

FIG. X1.3 Particles containing fibrils and nonasbestos materials (item 5.1.3): a) counts as zero structures because neither fibril protrudes by at least 0.5 μm; b) counts as one structure because the largest dimension of the interconnecting fibrils is greater than 0.5 μm; c) counts as zero structures because neither condition of item 5.1.3 is satisfied; d) counts as one structure because greater than 0.5 μm in length of one side of the fibril is visible; e) counts as zero structures because neither condition of item 5.1.3 is satisfied; f) counts as one structure because at least 0.5 μm of fibril length is visible.



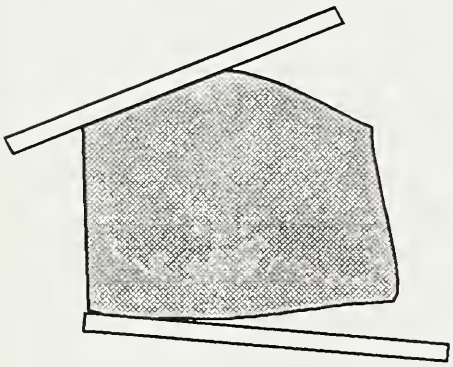
a

1 structure



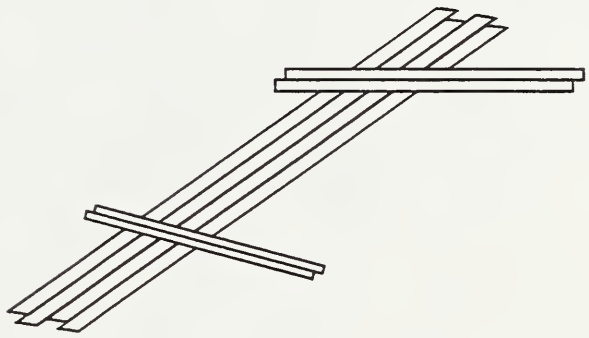
b

2 structures



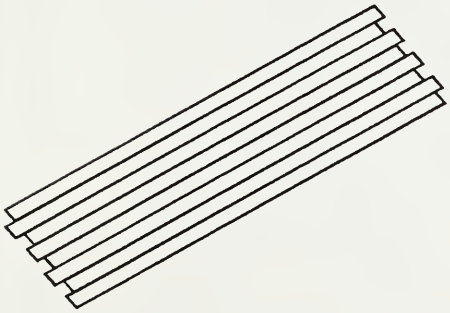
c

1 structure



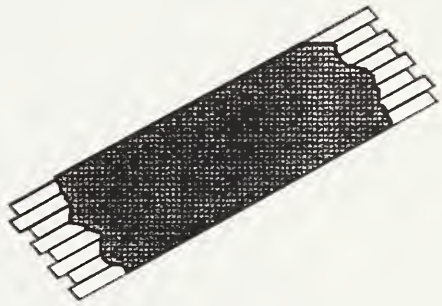
d

1 structure



e

1 structure



f

0 structures

FIG X1.4 Additional examples of the application of the counting rules: a) fibrils touching grid bars count as one structure; b) fibrils that are visibly separated count as separate structures; c-e) these particles count as one structure; f) no visible asbestos fibril has a length equal or greater than 0.5 µm and therefore the particle does not count as a structure.