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Standard Terminology for Sampling and Analysis of Asbestos¹

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1. Scope

1.1 This terminology standard is a collective vocabulary relating to sampling and analysis of asbestos. As a convenience to general interest, it contains most of the standard terms, definitions, and nomenclature under the jurisdiction of Committee D22.

1.2 Many of the entries in this terminology are copied (with attribution) from the standards of origin referenced in Section 2. The standards of origin are noted in bold type at the right margin of the applicable definition.

1.3 Certain terms in the common language that comprise multiple concepts are included herein with the definition specific to standards and practices of Committee D22.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:

- D1356** Terminology Relating to Sampling and Analysis of Atmospheres
- D5755** Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading
- D5756** Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Mass Surface Loading (Withdrawn 2017)²
- D6281** Test Method for Airborne Asbestos Concentration in Ambient and Indoor Atmospheres as Determined by Transmission Electron Microscopy Direct Transfer (TEM)
- D6480** Test Method for Wipe Sampling of Surfaces, Indirect Preparation, and Analysis for Asbestos Structure Number

¹ This terminology standard is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.07 on Sampling and Analysis of Asbestos.

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² The last approved version of this historical standard is referenced on www.astm.org.

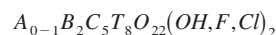
- Surface Loading by Transmission Electron Microscopy
- D6620** Practice for Asbestos Detection Limit Based on Counts
- D7200** Practice for Sampling and Counting Airborne Fibers, Including Asbestos Fibers, in Mines and Quarries, by Phase Contrast Microscopy and Transmission Electron Microscopy
- D7201** Practice for Sampling and Counting Airborne Fibers, Including Asbestos Fibers, in the Workplace, by Phase Contrast Microscopy (with an Option of Transmission Electron Microscopy)
- D7390** Guide for Evaluating Asbestos in Dust on Surfaces by Comparison Between Two Environments
- 2.2 *Government Standards:*
- USGS Open-File Report 02-458** Tabulation of Asbestos-Related Terminology

3. Terminology

acicular, *adj*—the shape shown by an extremely slender crystal with cross-sectional dimensions that are small relative to its length, that is, needle-like. **D6281**

activity generated aerosol, *n*—a dispersion of particles in air that have become airborne due to physical disturbances such as human activity, sweeping, airflow, etc. **D7390**

amphibole, *n*—a group of more than 60 different silicate minerals with similar crystal structures and complex compositions that conform to the nominal formula:



where:

- A* = K, Na, Ca;
- B* = Fe²⁺, Mn, Mg, Ca, Na;
- C* = Al, Cr, Ti, Fe³⁺, Mg, Fe²⁺; and
- Mn* and *T* = Si, Al, Cr, Fe³⁺, Ti.

In some varieties of amphibole, these elements can be partially substituted by Li, Pb, Zn, Be, Ba, or Ni. Amphiboles are characterized by a complex monoclinic or orthorhombic structure that includes a double chain of T-O tetrahedra with a T:O ratio of approximately 4:11; a variable morphology that ranges from columnar to prismatic to acicular to fibrous; and good prismatic cleavage at angles of about 56 and 124°. The cleavage may not be readily exhibited by small crystals that are bound by irregular growth and fracture surfaces. **D6281**

amphibole asbestos, *n*—amphibole in an asbestiform habit.

D6281

D6480

analytical sensitivity, *n*—the calculated airborne asbestos structure concentration in asbestos structures/L, equivalent to the counting of one asbestos structure in the analysis.

D6281

n—the calculated airborne asbestos structure concentration in asbestos structures/square centimeter, equivalent to counting of one asbestos structure in the analysis calculated using Eq. 2 in D6480.

D6480

area sample, *n*—an air sample collected so as to represent the concentration of airborne dust in a specific mine location, or area, or room of a workplace.

D7200

n—an air sample collected so as to represent the concentration of airborne dust in a specific area or room, which, in the case of this practice, refers to an area or room of a workplace.

D7201

asbestiform, *adj*—a special type of fibrous habit in which the fibers are separable into thinner fibers and ultimately into fibrils. This habit accounts for greater flexibility and higher tensile strength than other habits of the same mineral.

D5755

D5756

adj—a specific type of fibrous habit in which the fibers are separable into thinner fibers and ultimately into fibrils. This habit accounts for greater flexibility and higher tensile strength than other habits of the same mineral.

D6281

adj—a specific type of fibrous mineral growth habit in which the fibers and fibrils exhibit a polyfilamentous growth habit and possess high tensile strength and flexibility. All materials regulated as asbestos are asbestiform, but not all asbestiform minerals are classified as asbestos. Characteristics such as tensile strength and flexibility cannot be ascertained from microscopic evaluation.

D7200

D7201

asbestos, *n*—a collective term that describes a group of naturally occurring, inorganic, highly fibrous, silicate dominated minerals, which are easily separated into long, thin, flexible fibers when crushed or processed.

DISCUSSION—Included in the definition are the asbestiform varieties of: serpentine (chrysotile); riebeckite (crocidolite); grunerite (grunerite asbestos); anthophyllite (anthophyllite asbestos); tremolite (tremolite asbestos); and actinolite (actinolite asbestos). The amphibole mineral compositions are defined in accordance with the nomenclature of the International Mineralogical Association.

D5755

n—a collective term that describes a group of naturally occurring, inorganic, highly fibrous, silicate minerals, which are easily separated into long, thin, flexible fibers when crushed or processed.

DISCUSSION—Included in the definition are the asbestiform varieties of: serpentine (chrysotile); riebeckite (crocidolite); grunerite (amosite); anthophyllite (anthophyllite asbestos); tremolite (tremolite asbestos); and actinolite (actinolite asbestos). The amphibole mineral compositions are defined according to nomenclature of the International Mineralogical Association.

D5756

n—a collective term that describes a group of naturally occurring, inorganic, highly-fibrous, silicate minerals, that are easily separated into long, thin, flexible, strong fibers when crushed or processed.

DISCUSSION—Included in the definition are the asbestiform varieties of serpentine (chrysotile); riebeckite (crocidolite); grunerite (grunerite asbestos [Amosite]); anthophyllite (anthophyllite asbestos); tremolite (tremolite asbestos); and actinolite (actinolite asbestos). The amphibole mineral compositions are defined according to the nomenclature of the International Mineralogical Association.

D6281

D6480

n—a term applied to six specific silicate minerals belonging to the serpentine and amphibole groups, which have crystallized in the asbestiform habit, causing them to be easily separated into long, thin, flexible, strong fibers when crushed or processed. The Chemical Abstracts Service Registry Numbers of the most common asbestos varieties are: chrysotile (12001-29-5), riebeckite asbestos (crocidolite) (12001-28-4), grunerite asbestos (Amosite) (12172-73-5), anthophyllite asbestos (77536-67-5), tremolite asbestos (77536-68-6) and actinolite asbestos (77536-66-4). The precise chemical composition of each species varies with the location from which it was mined. Other amphibole minerals which exhibit the characteristics of asbestos have also been observed. The nominal compositions of the most common asbestos varieties are: Chrysotile $Mg_3Si_2O_5(OH)_4$, Crocidolite $Na_2Fe_3^{2+}Fe_2^{3+}Si_8O_{22}(OH)_2$, Amosite $(Mg,Fe)7Si_8O_{22}(OH)_2$, Anthophyllite $(Mg,Fe)7Si_8O_{22}(OH)_2$, Tremolite $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ [$Mg/(Mg+Fe^{2+})$ 0.9-1.0], Actinolite $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ [$Mg/(Mg+Fe^{2+})$ 0.5-0.9].

NOTE 1—Actinolite compositions in which $Mg/(Mg+Fe^{2+})$ is between 0 and 0.5 are referred to as ferroactinolite.

D7200

D7201

asbestos fiber, *n*—a fiber of asbestos that meets the criteria specified below for “fiber.” Phase Contrast Microscopy (PCM) does not identify fibers unequivocally as asbestos. Under the light microscope, a population of asbestos fibers may appear as a mixture of fiber agglomerates, fiber bundles (polyfilamentous growth, unique to asbestiform fibers), fibers with split ends, and single fibers, the relative occurrence and frequency of each type depending on the situation.

D7200

D7201

asbestos structure, *n*—a term applied to isolated fibers or to any connected or overlapping grouping of asbestos fibers or bundles, with or without other nonasbestos particles.

D6281

n—a term applied to isolated fibers or to any connected or overlapping grouping of asbestos fibers or bundles, with or without other nonasbestos particles.

D6480

aspect ratio, *n*—the ratio of the length of a fibrous particle to its average width.

D5755

D5756

n—the ratio of length to width of a particle.

D6281

D6480

n—the ratio of the length of a fiber to its width.

D7200

D7201

background, *n*—a statistical distribution of structures introduced by (i) analyst counting errors and (ii) contamination on an unused filter or contamination as a consequence of the sample collection and sample preparation steps.

DISCUSSION—This definition of background is specific to this practice. The only counting errors considered in this definition of background are errors that result in an over-count (that is, false positives). Analyst counting errors are errors such as, determining the length of structures or fibers and whether, based on length, they should be counted; counting artifacts as fibers; determining the number of structures protruding from a matrix; and interpreting a cluster as one, two, or more structures that should be counted only as zero or one structure. For purposes of developing the DL, assume that background contamination sources have been reduced to their lowest achievable levels. **D6620**

background samples, *n*—samples taken from surfaces that are considered to have concentrations of asbestos in surface dust that are representative of conditions that exist in an environment that is affected by only prevailing conditions and has not experienced events, disturbances or activities unusual for the environment. **D7390**

blank, *n*—a structure count made on TEM specimens prepared from an unused filter to determine the background measurement. **D6281**

n—a filter that has not been used to collect asbestos from the target environment. **D6620**

DISCUSSION—Blanks are used in this practice to determine the degree of asbestos contamination that is reflected in asbestos measurements. Contamination may be on the virgin filter or introduced in handling the filter in the field or when preparing it for inspection with a microscope. The data required to determine the degree of contamination consists, therefore, of measurements of field blanks that have experienced the full preparation process.

bundle, *n*—a structure composed of three or more fibers in a parallel arrangement with the fibers closer than one fiber diameter to each other. **D5755**
D5756
D6480

camera length, *n*—the equivalent projection length between the specimen and its electron 195 diffraction pattern, in the absence of lens action. **D6281**
D6480

chrysotile, *n*—a group of fibrous minerals of the serpentine group that have the nominal composition $Mg_3Si_2O_5(OH)_4$ and have the crystal structure of either clinochrysotile, orthochrysotile, or parachrysotile. Most natural chrysotile deviates little from this nominal composition. Chrysotile may be partially dehydrated or magnesium-leached, both in nature and in building materials. In some varieties of chrysotile, minor substitution of silicon by Al^{3+} may occur. Chrysotile is the most prevalent type of asbestos. **D6281**
D6480

cleavage, *v*—the breaking of a mineral along one of its crystallographic directions. **D6281**

cleavage fragment, *n*—a fragment of a crystal that is bounded in whole or in part by cleavage faces. Some cleavage

fragments would be included in the fiber definition used in this method. **D6281**

n—mineral particles, normally formed by comminution of minerals, which often are characterized by parallel sides and a moderate aspect ratio (usually less than 20:1). Non-asbestiform cleavage fragments do not exhibit fibrillar bundling at any level of examination. **D7200**

cluster, *n*—a structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group; groupings of fibers must have more than two points touching. **D5755**
D6480

n—an aggregate of two or more randomly oriented fibers, with or without bundles. Clusters occur as two varieties: disperse clusters and compact clusters. **D5756**

n—a structure in which two or more fibers or fiber bundles are randomly oriented in a connected grouping. **D6281**

compact cluster, *n*—a complex and tightly bound network in which one or both ends of each individual fiber or bundle are obscured, such that the dimensions of individual fibers or bundles cannot be unambiguously measured. **D5756**

compact matrix, *n*—a structure consisting of a particle or linked group of particles, in which fibers or bundles can be seen either within the structure or projecting from it, such that the dimensions of individual fibers and bundles cannot be unambiguously determined. **D5756**

control, *n*—an area that is used as the basis for a comparison. This could be an area where the dust has been previously characterized, an area thought to be suitable for occupancy, an area that has not experienced a disturbance of asbestos-containing materials, or that is for some other reason deemed to be suitable as the basis for a comparison. **D7390**

control samples, *n*—samples collected for comparison to the study samples. These differ from background samples in that they are collected either: in an area where the dust has been previously characterized, or in an area that has not experienced a disturbance of asbestos containing materials, or in an area that is for some other reason deemed to be suitable as the basis for comparison. **D7390**

count, *n*—the number of fibers or structures identified in a sample. **D6620**

d-spacing or interplanar spacing, *n*—the perpendicular distance between identical adjacent and parallel planes of atoms in a crystal. **D6480**

d-value or interplanar spacing, *n*—the perpendicular distance between identical adjacent and parallel planes of atoms in a crystal. **D6281**

debris, *n*—materials that are of an amount and size (particles greater than 1 mm in diameter) that can be visually identified as to their source. **D5755**

n—materials that are of an amount and size (particles greater than 1 mm in diameter as defined by a 1.0 by 1.0 mm