Tabulation of Asbestos-Related Terminology

By Heather Lowers and Greg Meeker

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Abstract

The term asbestos has been defined in numerous publications including many State and Federal regulations. The definition of asbestos often varies depending on the source or publication in which it is used. Differences in definitions also exist for the asbestos-related terms acicular, asbestiform, cleavage, cleavage fragment, fiber, fibril, fibrous, and parting. An inexperienced reader of the asbestos literature would have difficulty understanding these differences and grasping many of the subtleties that exist in the literature and regulatory language. Disagreement among workers from the industrial, medical, mineralogical, and regulatory communities regarding these definitions has fueled debate as to their applicability to various morphological structures and chemical compositions that exist in the amphibole and serpentine groups of minerals. This debate has significant public health, economic and legal implications. This report summarizes asbestos-related definitions taken from a variety of academic, industrial, and regulatory sources. This summary is by no means complete but includes the majority of significant definitions currently applied in the discipline.

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Introduction

Ongoing debate in the asbestos community involves a variety of issues, many of which center around nomenclature. A novice to the asbestos literature would have difficulty grasping the significance and subtleties of the many terms used to describe various asbestos-related mineralogical structures. To confound the issue, many of these terms carry different definitions, depending upon the source that is consulted. The purpose of this report is to give the user a consolidated source of the various definitions that have been put forth and are being used. This report is not intended to endorse any particular definition, but rather point out the variations, differences and inconsistencies that exist in the literature.

The tables in this report present a compilation of definitions that have been put forth by mineralogical, industrial, regulatory, and medical workers over the last thirty years for the terms acicular, asbestiform, asbestos, cleavage, cleavage fragments, fiber, fibril, fibrous, and parting. Some definitions of these terms vary from source to source simply because they are intended for specific application in analytical methods. An example is the term *fiber* that may be defined simply by length and width criteria for the purpose of structure counting. Such a definition may not be applicable to a more general use of the term and should not be broadly applied. A person choosing to read an asbestos-related document should be aware of the intent of the definition in the particular publication.

The information in this report is presented in table format. The first column in each table, headed community, will contain one of five categories: interdisciplinary, industrial, medical, mineralogical, or regulatory (including test methods) based on the discipline of the publication in which the term appears. The second heading gives the year the source was published. This allows the reader to see the evolution, if any, of the terms over the years. The third column gives the complete reference for the source indicated. The fourth column includes the definition(s) for each asbestos-related term that is defined in the source. Each table is titled by the term being defined. In all cases, the

definitions of the terms were taken word for word from the source. Comments by the authors of this report are designated by italicized text enclosed by brackets. The same source was searched for all the terms given in this report. If a term was not defined, located, or used in the source, “NA” will appear in the respective column.

This tabulation is by no means complete, but includes the spectrum of definitions given in the academic, industrial, and regulatory literature. It is clear that there is disagreement and perhaps misunderstanding regarding some of the terminology used by workers in various asbestos-related fields. It is hoped that this report will assist the reader in evaluating and understanding the thousands of asbestos-related documents in the literature. For additional perspectives of the evolution of the terms defined in this report, the reader is referred to the following sources:

Langer, A.M., Rohl, A.N., Wolff, M., Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments: Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.

Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.

National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.

Table 1. Acicular

Community	Year	Source	Acicular
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	NA
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA

Table 1. Acicular

Community	Year	Source	Acicular
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	ACICULAR crystals are crystals that are extremely long and thin and have a small diameter. (An acicular crystal is a special type of PRISMATIC crystal. A prismatic crystal has one elongated dimension and two other dimensions that are approximately equal.) As defined by the American Geological Institute (1980), a mineral fragment must be at least three times as long as it is wide to be called acicular. Acicular crystals or fragments are not expected the have the strength, flexibility, or other properties of asbestiform fibers.
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	needlelike
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	Needle-shaped or needlelike. The term is ordinarily applied in mineralogy to straight, greatly elongate, free-standing (individual) crystals bounded laterally, and terminated, by crystal faces. Aggregates of acicular crystals often occur in open, bristly groups. The aspect ratio of acicular crystals is in the same range of those of "fiber" and "fibrous", but the thickness may extend to several millimeters.

Table 1. Acicular

Community	Year	Source	Acicular
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	Having the shape of a needle: *acicular crystals*
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA

Table 1. Acicular

Community	Year	Source	Acicular
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	The shape shown by an extremely slender crystal with small cross-sectional dimensions (a special case of prismatic form). Acicular crystals may be blunt-ended or pointed. The term "needlelike" refers to an acicular crystal with pointed termination at one or both ends.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	**[cryst]** Said of a crystal that is needlelike in form. Cf: *fascicular; sagenitic.*

Table 1. Acicular

Community	Year	Source	Acicular
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	syn. Needle-like fibre, fibrous, hair-like
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	needle-like
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	Slender, needlelike crystals.
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	NA
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	As the length increases relative to the width, the crystals are called acicular.
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	Occurs as needle-like crystals.
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA

Table 1. Acicular

Community	Year	Source	Acicular
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	NA
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	NA
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	The shape of an extremely slender crystal with cross-sectional dimensions which are small relative to its length, i.e. needle-like.

Table 1. Acicular

Community	Year	Source	Acicular
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	The asbestiform habit is most commonly developed in certain amphiboles and chrysotile, but other minerals also may crystallize with this unusual habit. The habit may be characterized by (1) a fibril structure, single or twinned crystals of very small widths (generally less than 0.5 um), which have grown with a common fiber axis direction, but are disoriented in the other crystallographic directions; (2) anomalous optical properties, primarily parallel extinction; (3) unusual tensile strengths; (4) high aspect ratio; and (5) flexibility.
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	A special type of fibrous habit in which the fibers are separable, and are more flexible and possess higher tensile strength than crystals in other habits of the same mineral.
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	ASBESTIFORM HABIT refers to the unusual crystallization habit of a mineral when the crystals are thin, hairlike fibers. Historically, the definition of the asbestiform habit was based primarily on appearance, and the properties were only implied. At present, the definition of asbestiform habit is often augmented to include a statement on the properties of asbestiform fibers, i.e., shape; enhanced strength, flexibility, and durability; diameter-dependent strength; and unique surfaces. The fibers of asbestos are good examples of the asbestiform habit.
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	...a mineral structured in the form of asbestos
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	An adjective used to describe inorganic materials that possess the form and appearance of asbestos (OED, WEB). Asbestine, asbestoid, and asbestos are obsolete synonyms. Asbestiform materials are a subset of fibrous materials. The term should be employed only when the material is one of the minerals mined as asbestos and possesses fibrosity typical of asbestos-that is, with relatively small fiber thickness, flexibility, separability, and general parallel arrangement of fibers en masse. The term asbestiform has also been used to imply that a sample or an individual fiber has morphological (gross external) characteristics similar to those of asbestos, but not necessarily the chemical or other physical properties of asbestos. In the 1700s asbestiform was used for the fibrous members of the amphibole group only. At that time virtually all asbestos in common use was amphibole-asbestos.
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	NA
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	Asbestiform fibers are those having the crystal structure of the above minerals and having physical characteristics such as (1) mean aspect ratios (length to width) of 20:1 to 100:1 or greater for individual fibers; (2) very thin fibrils usually less than 0.5 um in width; (3) and parallel fibers in bundles with splayed ends, matted masses of fibers, and/or fibers showing curvature.
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	A term used to describe minerals that possess a habit and appearance similar to that displayed by asbestos.
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	...denotes an asbestos variety of silicate fiber; it may be used as a synonym for asbestos (Campbell et al., 1979; Zoltai, 1978). Although recommended, a current dictionary of geological terms suggests that asbestiform may be used to describe fibers which merely resemble asbestos (Thrush, 1978)
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	A specific type of mineral fibrosity in which the fibers and fibrils posses high tensile strength and flexibility.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	Said of a mineral that is fibrous, i.e. that is like asbestos.
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	The term asbestiform refers to minerals that are mined as asbestos and possess fibrosity typical of asbestos-that is, with small fiber thickness, flexibility, and separability.

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	...any mineral resembling asbestos is asbestiform
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	When the length is extremely long compared with the width, the crystals are called asbestiform or fibrous.
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	The asbestiform habit can be defined as a habit where mineral crystals grow in a single dimension, in a straight line until they form long, thread-like fibers with aspect ratios of 20:1 to 100:1 and higher.

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	(morphology) Said of a mineral that is like asbestos, i.e., crystallized with the habit of asbestos. Some asbestiform minerals may lack the properties which make asbestos commercially valuable, such as long fiber length and high tensile strength. With the light microscope, the asbestiform habit is generally recognized by the following characteristics: 1) Mean aspect ratios ranging from 20:1 to 100:1 or higher for fibers longer than 5 um. Aspect ratios should be determined for fibers, not bundles. 2) Very thin fibrils, usually less than 0.5 micrometers in width, and 3) Two or more of the following: a) Parallel fibers occurring in bundles, b) Fiber bundles displaying splayed ends, c) matted masses of individual fibers, and/or d) Fibers showing curvature. These characteristics refer to the population of fibers as observed in a bulk sample. It is not unusual to observe occasional particles having aspect ratios of 10:1 or less, but it is unlikely that the asbestos component(s) would be dominated by particles (individual fibers) having aspect ratios of <20:1 for fibers longer than 5um. If a sample contains a fibrous component of which most of the fibers have aspect ratios of <20:1 and that do not display the additional asbestiform characteristics, by definition the component should not be considered asbestos.
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	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.

Table 2. Asbestiform

Community	Year	Source	Asbestiform
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	A specific type of mineral fibrosity in which the fibres and fibrils posses high tensile strength and flexibility.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 3. Asbestos

Community	Year	Source	Asbestos
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	...is a generic name given to a group of fibrous mineral silicates found in nature. They are all incombustible and can be separated by mechanical means into fibers of various lengths and cross sections, but each differs in chemical composition from the other.
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	...is a generic name given to six fibrous minerals that have been used in commercial products. The six types of asbestos are chrysotile, the most widely used; crocidolite; amosite; anthophyllite asbestos; tremolite asbestos; and actinolite asbestos. The properties that make asbestos so versatile and cost effective are high tensile strength, chemical and thermal stability, high flexibility, low electrical conductivity, and larger surface area.
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	The term "asbestos" is a nonscientific commercial term normally restricted in use to the long, threadlike fibrous varieties of several hydrated silicate minerals, whose fibers can be separated mechanically and pressed, spun, or woven into articles of all types that are resistant to heat and chemical alteration. Although present usage is generally limited to the commercially available silicate minerals, chrysotile, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos, other minerals regardless of chemical composition, which posses similar qualities of great elongation, flexibility, high-tensile strength, heat and chemical resistance, spinability, etc., could properly be classified as asbestos.
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	A collective mineralogical term which includes the asbestiform varieties of various (silicate) minerals.

Table 3. Asbestos

Community	Year	Source	Asbestos
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	Asbestos is a term used to describe a number of minerals which have the property that they can be separated into long silky fibres.
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	[*Author quotes the federal register*] 1. Asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite and actinolite. 2. "Asbestos fibers" means asbestos fibers longer than 5 micrometers.
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	[*uses Code of Federal Regulations*] "asbestos" is recognized as generic, applicable to a number of hydrated silicates, but its use is specifically limited to describe the minerals chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	...meaningful working definition of asbestos, we propose the following: 1. For routine method, a minimum aspect ratio of 10:1 should be used in a screening analysis or survey. Existing data indicate that this would not affect the chrysotile analysis at all and amphibole analysis only when the sample contains a significant percentage of acicular nonasbestos particles [11-16]. While this would undoubtedly result in missing 5 to 20 percent of the short asbestos particles, it would eliminate 70 to 80 percent of the nonasbestos particles from consideration. 2. A lower length limit for routine electron microscope analysis should be adopted. On the basis of available information, a reasonable limit would be somewhere between 0.75 and 2.0 microns [3]. 3. Asbestos analyses should be grouped into at least three size fractions and acceptable uncertainty levels defined for each range. For example, the length categories less than 2, 2 to 5, and greater than 5 um might be chosen, and a 50 percent relative error defined as the minimum level of acceptance for each size range.

Table 3. Asbestos

Community	Year	Source	Asbestos
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	The term ASBESTOS is a commercial-industrial term rather than a mineralogical term. It refers to well-developed and hairlike long-fibered varieties of certain minerals that satisfy particular industrial needs. Table 2-1 lists the names of chemical formulas of the minerals included in the term asbestos. Other minerals used in industry, such as palygorskite, may also crystallize as well-developed, thin hairlike fibers (i.e., in the asbestiform habit), but they are not called asbestos. [*Minerals listed in Table 2-1: chrysotile, riebeckite, anthophyllite, cummingtonite-grunerite, actinolite-tremolite*]
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	...a generic term for naturally occurring inorganic hydrated silicates, occurring in layered structures composed of chains of silicon/oxygen tetrahedra, which can subdivide into flexible fibers
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	...a term applied to six naturally occurring minerals exploited commercially for their desirable physical properties, which are in part derived from their asbestiform habit. The six minerals are the serpentine mineral chrysotile and the amphibole minerals grunerite asbestos (also referred to as amosite), riebeckite asbestos (also referred to as crocidolite), anthophyllite asbestos, tremolite asbestos, and actinolite asbestos... Individual mineral particles, however processed and regardless of their mineral name, are not demonstrated to be asbestos if the length-to-width ratio is less than 20:1.

Table 3. Asbestos

Community	Year	Source	Asbestos
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	A commercial and generally used name for fibrous varieties of naturally occurring silicate minerals of the amphibole or serpentine group (see chapter 2). Over the millennia many fibrous minerals have been called asbestos, including the six minerals presently accepted (see in the following), as well as other silicates such as palygorskite and nonsilicates such as brucite. The characteristics of mineral materials that have invoked the use of the term asbestos are: slender fibers that are easily separable and flexible, and fine fibers that have high tensile strength, chemical stability, and are incombustible. Natural unprocessed asbestos fibers have large aspect ratios and may have lengths of microscopic dimensions up to, in rare instances, a meter or so. Chrysotile-asbestos fibers are commonly 10 centimeters in length...Asbestos is used as an adjective in combination with numerous other words and phases, such as asbestos cement.
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	"Asbestos" is a broad commercial term for a group of naturally occurring hydrated silicates that crystallize in a fibrous habit.
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	n. Either of two incombustible, chemical-resistant, fibrous mineral forms of impure magnesium silicate, used for fireproofing, electrical insulation, building materials, brake linings, and chemical filters.
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA

Table 3. Asbestos

Community	Year	Source	Asbestos
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	Asbestos is a commercial term for long, thin mineral fibers of chrysotile, amosite, crocidolite, anthophyllite, tremolite, and actinolite.
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	A commercial term that describes a group of extremely thin and flexible minerals that have a unique combination of physical and chemical properties. The long asbestos fibers can be spun in yarn and then made into woven fabric. Asbestos is derived from a Greek word meaning inextinguishable in the sense of indestructible, because asbestos cannot be destroyed by fire. Modern usage in mineralogy occurred when the term was applied to a fibrous amphibole mineral discovered in the Alps.
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	Asbestos refers to a group of inorganic silicates which occur naturally and have a distinct fibrous crystalline structure, which is largely responsible for its unique properties: tensile strength, stiffness, heat resistance, and ability to split into finer fibres.
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	The term "asbestos" may be used to describe a mineral species only when its physical characteristics, on the megascopic level, are known: the mineral fiber possesses tensile strength, flexibility, and those other characteristics which distinguishes asbestiform minerals from their rock-forming analogues. Asbestos may also be applied to submicroscopic fibers if the source materials are known; for example, in an asbestos textile factory where chrysotile fiber is used.
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	...refers to a group of naturally occurring fibrous metallic silicates that have been used widely in construction and industry.

Table 3. Asbestos

Community	Year	Source	Asbestos
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	...is a generic name given to a class of natural fibrous silicates that vary considerably in their physical and chemical properties.
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	Asbestus. Asbestos. Tremolite, actinolite, and other varieties of amphibole, excepting those containing much alumina, pass into fibrous varieties, the fibers of which are sometimes very long, fine, flexible, and easily separable by the fingers and look like flax. These kinds are called asbestus.
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	(1) A collective mineralogical term encompassing the asbestiform varieties of various minerals; (2) an industrial product obtained by mining and processing primarily asbestiform minerals.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	(a) A commercial term applied to a group of highly fibrous silicate minerals that readily separate into long, thin, strong fibers of sufficient flexibility to be woven, are heat resistant and chemically inert, and possess a high electric insulation, and therefore are suitable for uses (as in yarn, cloth, paper, paint, brake linings, tiles, insulation, cement, fillers, and filters) where incombustible, nonconducting, or chemically resistant material is required. (b) A mineral of the asbestos group, principally chrysotile (best adapted for spinning) and certain fibrous varieties of amphibole (esp. tremolite, actinolite, and crocidolite). (c) A term strictly applied to the fibrous variety of actinolite.---Syn: *asbestus; amianthus; earth flax; mountain flax*.
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	In this study, only specimens [*in reference to calcic amphiboles*] which occur as bundles of fibres (commonly having splayed ends), which readily split into still finer sub-microscopic units (fibrils), are referred to and are classed as asbestos.

Table 3. Asbestos

Community	Year	Source	Asbestos
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	The characteristic morphology of all asbestos minerals, in their natural form, is a parallel-sided fiber with a length to width ratio (referred to as an aspect ratio) in excess of 100:1 (Champness, P.E., Cliff, G. and Lorimer, G.W., 1976, The identification of asbestos, *Journal of Microscopy*, v. 108, pp. 231-249).
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	Asbestos is defined as a group of highly fibrous silicate minerals that readily separate into long, thin, strong fibers that have sufficient flexibility to be woven, are heat resistant and chemically inert, are electrical insulators, and therefore are suitable for uses where incombustible, nonconducting, or chemically resistant material is required.
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	...is a generic name given to the fibrous variety of six naturally occurring minerals that have been used in commercial products. Asbestos is made up of fiber bundles. These bundles, in turn, are composed of extremely long and thin fibers that can be easily separated from one another. The bundles have splaying ends and are extremely flexible. The term "asbestos" is not a mineralogical definition. It is a commercial designation for mineral products that possess high tensile strength, flexibility, resistance to chemical and thermal degradation, and high electrical resistance and that can be woven.
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	...is a generic term for a number of hydrated silicates that, when crushed or processed, separate into flexible fibers made up of fibrils.
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	Asbestos fibers are defined as those particles with a length greater than 5 um and a length-to-diameter ratio of 3:1, or greater.
Regulatory	1983	29 CFR 1910.1001	For the purpose of this section, (1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

Table 3. Asbestos

Community	Year	Source	Asbestos
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	"Asbestos" means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite tremolite.
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, cummingtonite-grunerite asbestos (amosite), anthophyllite asbestos, tremolite asbestos, crocidolite, actinolite asbestos and any of these minerals which have been chemically treated or altered. The precise chemical formulation of each species varies with the location from which it was mined.
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	A commercial term applied to the asbestiform varieties of six different minerals. The asbestos types are chrysotile (asbestiform serpentine), amosite (asbestiform grunerite), crocidolite (asbestiform riebeckite), and asbestiform anthophyllite, asbestiform tremolite, and asbestiform actinolite. The properties of asbestos that caused it to be widely used commercially are: 1) its ability to be separated into long, thin flexible fibers; 2) high tensile strength; 3) low thermal and electrical conductivity; 4) high mechanical and chemical durability, and 5) high heat resistance.
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	...is a widely used, mineral-based material that is resistant to heat and corrosive chemicals. Typically, asbestos appears as a whitish, fibrous material which may release fibers that range in texture from coarse to silky; however, airborne fibers that can cause health damage may be too small to see with the naked eye.
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	...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.

Table 3. Asbestos

Community	Year	Source	Asbestos
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	A term applied to a group of 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, strong fibres when crushed or processed. The Chemical Abstracts Service Registry Numbers of the common asbestos varieties are: chrysotile (12001-29-5), 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).
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	means asbestiform varieties of chrysotile, amosite (cummingtonite-grunerite), crocidolite, anthophyllite, tremolite, and actinolite.
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, cummingtonite-grunerite asbestos (amosite), anthophyllite asbestos, tremolite asbestos, crocidolite, actinolite asbestos and any of these minerals which have been chemically treated or altered. The precise chemical formulation of each species varies with the location from which it was mined...
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	Asbestos. Any naturally occurring hydrated mineral silicate separable into commercially usable fibers, including chrysotile (serpentine), amosite (cummingtonite-grunerite), crocidolite (riebeckite), tremolite, anthophyllite and actinolite.
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	...means the asbestiform varieties of: Chrysotile (serpentine); crocidolite (riebeckite); amosite (cummingtonite-grunerite); anthophyllite; tremolite; and actinolite.
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

Table 3. Asbestos

Community	Year	Source	Asbestos
Regulatory	2001	30 CFR 56.5001	..."Asbestos" is a generic term for a number of hydrated silicates that, when crushed or processed, separate into flexible fibers made up of fibrils. Although there are many asbestos minerals, the term "asbestos" as used herein is limited to the following minerals: chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.
Regulatory	2001	17 CCR (California Code of Regulations) 93105	"Asbestos" means asbestiforms* of the following minerals: chrysotile (fibrous serpentine), crocidolite (fibrous riebeckite), amosite (fibrous cummingtonite--grunerite), fibrous tremolite, fibrous actinolite, and fibrous anthophyllite. *[*It is assumed that the authors of the above entry intended for the word "asbestiforms" to be interpreted as asbestiform varieties of these minerals. This unusual application of the term would probably not be considered appropriate by most workers in the mineralogical community*.]
Regulatory	2001	West Virginia Code 16-32-2	Asbestos means the asbestiform varieties of chrysotile (serpentine), crocidolite (riebeckite), amosite (cummingtonite-grunerite), anthophyllite, tremolite and actinolite.
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	"Asbestos" means the asbestiform varieties of serpentine (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite (amosite), anthophyllite, actinolite and tremolite.
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	"Asbestos" means the asbestiform varieties of chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

Table 4. Cleavage

Community	Year	Source	Cleavage
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	NA
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	A mineral has cleavage if it breaks along definite plane surfaces.
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA

Table 4. Cleavage

Community	Year	Source	Cleavage
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	CLEAVAGE refers to the preferential breakage of crystals along certain planes of structural weakness. Such planes of weakness are called cleavage planes. A mineral with two distinct cleavage planes will preferentially fracture along these planes and will produce ACICULAR fragments...The strength and flexibility of cleavage fragments are approximately the same as those of single crystals. Cleavage cannot produce the high strength and flexibility of asbestiform fibers.
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	NA
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	The property of an individual crystal to fracture or break, producing planar surfaces along specific crystallographic directions dictated by the structure of the material. Some crystals lack cleavage; others possess one or more crystallographically distinct cleavage directions (see chapter 1).
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA

Table 4. Cleavage

Community	Year	Source	Cleavage
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	1. Mineralogy. The splitting or tendency to split of a crystallized substance along definite crystalline planes, yielding smooth surfaces.
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	weakness inherent in a "perfect" structure
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	...in minerals is normally defined as planar separation occurring along crystallographic planes with the lowest surface energies.

Table 4. Cleavage

Community	Year	Source	Cleavage
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	...is a fracture yielding a more or less smooth surface in the crystal, usually along one of the principal planes of the lattice. The cleavage is characterized by the plane, the ease of production and the character of the surface
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	The tendency of a crystal to break in definite directions that are related to the crystal structure and are always parallel to possible crystal faces.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	[mineral] The breaking of a mineral along its crystallographic planes, thus reflecting crystal structure. The types of cleavage are named according to the structure, e.g. prismatic cleavage. Cf: fracture [mineral]; parting [cryst].
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA

Table 4. Cleavage

Community	Year	Source	Cleavage
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	...is the tendency of minerals to break parallel to atomic planes that are identified by Miller indices, just as the faces of the external form of a crystal
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	Cleavage refers to breakage of a mineral on an approximately planar surface that is controlled by its crystal structure.
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	NA
Mineralogical	2002	http://webmineral.com/help/Fracture.html	If a mineral is strained beyond its elastic limits, it will break. If it breaks irregularly then it shows fracture, if it breaks along regular surfaces related to the crystal structure then it shows cleavage. This cleavage depends on weaknesses in the crystalline make-up of the mineral and is a diagnostic property which can reveal additional information about the mineral.
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA

Table 4. Cleavage

Community	Year	Source	Cleavage
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	NA
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	NA
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	The breaking of a mineral along one of its crystallographic directions.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA

Table 4. Cleavage

Community	Year	Source	Cleavage
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	NA
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	...The strength and flexibility of cleavage fragments are approximately the same as those of single crystals. Cleavage cannot produce the high strength and flexibility of asbestiform fibers.
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	NA
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	Cleavage fragments are mineral particles which are similar to asbestiform fibers but have low aspect ratios.
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	A fragment produced by the breaking of crystals in directions that are related to the crystal structure and are always parallel to possible crystal faces.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	A fragment of a crystal that is bounded by cleavage faces.
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	NA
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	NA
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	NA
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	Mineral particles formed by the comminution of minerals, especially those characterized by relatively parallel sides and moderate aspect ratio.
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	NA
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	NA
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	A fragment of a crystal that is bounded by cleavage faces.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA

Table 5. Cleavage Fragment

Community	Year	Source	Cleavage Fragment
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	Mineral particles formed by the comminution of minerals, especially those characterized by parallel sides and moderate aspect ratio (usually less than 20:1).
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 6. Fiber

Community	Year	Source	Fiber
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	The term "fiber" connotes a greatly elongated particle with threadlike qualities such as high-tensile strength, flexibility, spinability, etc.
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	An acicular single crystal, or a similarly elongated polycrystalline aggregate, which displays some resemblance to organic fibers.
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	[*Author uses Code of Federal Regulations*] "fiber" is defined as any particulate with a three to one or greater length to width aspect ratio, and a length of five micrometers or longer.

Table 6. Fiber

Community	Year	Source	Fiber
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	Fibers are defined as all fragments having aspect ratios greater than 3:1, with lengths exceeding 5 um and having diameters smaller than 3 um.
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	The term MINERAL FIBERS has traditionally referred to crystals whose appearance and properties resembled organic fibers, such as hair and cotton. In some recent literature, however, the term sometimes refers only to the appearance of the material, and there can be confusion about whether particular properties are also implied.
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	NA
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	...inorganic fibers in a general sense: as small elongate solid objects composed of any compound or element; usually nonbiologic in origin and often exhibiting distinctive physical, especially mechanical, properties. Inorganic fibers can occur naturally, that is, as mineral fibers or can be produced synthetically.
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA

Table 6. Fiber

Community	Year	Source	Fiber
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	NA
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA

Table 6. Fiber

Community	Year	Source	Fiber
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	(mineral fiber) The smallest elongated crystalline unit that can be separated from a bundle or appears to have grown individually in that shape, and that exhibits a resemblance to organic fibers. (Examples: fiber bundles, chrysotile, and crocidolite; individual fibers, epsomite and millerite.)
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	An elongated, tapering, thick-walled strengthening cell occurring in various parts of vascular plants (Esau, 1953).
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA

Table 6. Fiber

Community	Year	Source	Fiber
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	A long, thin thread or threadlike solid with distinctive elongate shape that may be natural or synthetic and organic or inorganic in composition. The properties of flexibility and toughness are also implied, especially to the layperson, but are not essential to the definition. The dimensions of an object called a fiber are usually unspecified and may range from the visible (diameter about a millimeter, and a length many times the thickness) to a particle that can be observed only with the aid of a light or an electron microscope (magnification greater than X50,000). The physical dimensions of vegetable fibers such as flax, hemp, or cotton; animal fibers such as wood, silk, and hair; mineral fibers, such as asbestos; and synthetic fibers such as nylon and glass usually have diameters between 1 and 500 micrometers and lengths between 10 and 1000 micrometers. Inorganic fibers may be flexible and elastic or stiff and brittle, and they commonly occur as aggregates or fibrous bundles. Most mineralogists apply the term when the aspect ratio of a mineral sample, individual or aggregate, is at least 10.
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	NA
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	NA
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	NA
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	...a mineral which is at least three times as long as it is wide

Table 6. Fiber

Community	Year	Source	Fiber
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	Asbestos fibers are defined as those particles with a length greater than 5 um and a length-to-diameter ratio of 3:1, or greater.
Regulatory	1983	29 CFR 1910.1001	(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	A particle longer than or equal to 5 um with a length to width ratio greater than or equal to 3:1. This may include cleavage fragments.
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	With reference to asbestiform morphology, a structure consisting of one or more fibrils.
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	a structure having a minimum length of 0.5 um, an aspect ratio of 5:1 or greater, and substantially parallel sides

Table 6. Fiber

Community	Year	Source	Fiber
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	(fibre) An elongated particle which has parallel or stepped sides. For the purposes of this International Standard, a fibre is defined to have an aspect ratio equal to or greater than 5:1 and a minimum length of 0.5 um.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	A particle that is 5 um or longer, with a length-to-width ratio of 3 to 1 or longer.
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	A structure greater than or equal to 0.5 um in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.
Regulatory	2001	29 CFR 1910.1001	Fiber means a particulate form of asbestos 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 7. Fibril

Community	Year	Source	Fibril
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	A fibril is single or twinned crystal with a very small width, generally less than 0.5 um, and an extremely high aspect ratio; bundle of fibrils may have lengths reaching into the cm.
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	NA
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA

Table 7. Fibril

Community	Year	Source	Fibril
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	NA
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	...a single crystal in the form of a fiber
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA

Table 7. Fibril

Community	Year	Source	Fibril
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	A small fiber or the subdivision of a fiber (OED); also a small thread or fiber (WEB). The term is usually employed to describe an elongate unit whose dimensions are smaller than fiber (fine-fibrous) and may be used to designate one member of a fibrous mineral aggregate, regardless of the size of the individual particles or the aggregate. In the latter usage, the implication is that a fibril is the smallest unit that expresses the characteristics of a fiber or fibrous mass, and usually that the fibril is separable by subdivision parallel to the length of the fiber. For example, chrysotile asbestos could theoretically be disaggregated to tubular individual fibrils with diameters in the range of 200 A. The term fibril therefore has an ultimate lower limit. Fibril is also related to the term polymer, which is defined as a chemical compound or mixture of compounds formed by polymerization and consisting of essentially repeating structural units, usually producing giant chainlike macromolecules. Such a molecule is characterized by highly asymmetric geometry and anisotropic properties. If a solid is formed from polymers, a fibril would be the smallest polymeric unit.
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	1. A small slender fiber or filament
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA

Table 7. Fibril

Community	Year	Source	Fibril
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	Chrysotile having a high magnesium content can be described as a sheet silicate in which the flat structure is rolled about an axis to form a narrow tube (termed fibril) possessing both strength and flexibility.
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA

Table 7. Fibril

Community	Year	Source	Fibril
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	A single fiber, which cannot be separated into smaller components without losing its fibrous properties or appearances.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	NA
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	NA

Table 7. Fibril

Community	Year	Source	Fibril
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	Fibrils are single, elementary fibers that have very small width.
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	NA
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	The individual unit of structure of fibers.

Table 7. Fibril

Community	Year	Source	Fibril
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	a single fiber that cannot be separated into smaller components without losing its fibrous properties or appearance.
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	A single fibre of asbestos, which cannot be further separated longitudinally into smaller components without losing its fibrous properties or appearances.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA

Table 7. Fibril

Community	Year	Source	Fibril
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 8. Fibrous

Community	Year	Source	Fibrous
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	The descriptive term used for a mineral which is composed of parallel, radiating or interlaced aggregates of fibers, from which the fibers are usually separable.
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	NA

Table 8. Fibrous

Community	Year	Source	Fibrous
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	FIBROUS refers to (1) single crystals that resemble organic fibers such as hair or cotton and (2) large crystals or crystalline aggregates that look like they are composed of fibers (I.e., long, thin, needlelike elements) (Dana and Ford, 1932). The apparent fibers do not need to be separable. If the fibers are separable and are strong and flexible, they are ASBESTIFORM. If they have the normal strength and brittleness of the mineral, they are ACICULAR. If the apparent fibers are not separable, the specimen may be a single crystal or a multiple (polycrystalline) aggregate displaying a fibrous pattern (resulting, for example, from striation or pseudomorphic replacement of an initially fibrous mineral).
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	fibrous particulate-fibers, fiber fragments, and fiber agglomerates
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA

Table 8. Fibrous

Community	Year	Source	Fibrous
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	Full of fibers, or formed of fibers (OED), with dimensions unspecified but implied, by comparison, to be similar to the natural materials thread and hair (see Fiber). Aggregates of any size of individual fibers may form relatively thick fibrous bundles, thus becoming visible to the naked eye.
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	1. Having, consisting of, or resembling fibers.
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	NA
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA

Table 8. Fibrous

Community	Year	Source	Fibrous
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	NA
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	The occurrence of a mineral in bundles of fibers, resembling organic fibers in texture, from which the fibers can usually be separated (for example, satin-spar and chrysotile).
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	The term fibrous is used in a general mineralogical way to describe any aggregates of grains that crystallize in a needlelike habit and appear to be composed of fibers.
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	Said of the habit of a mineral, and of the mineral itself (e.g. asbestos), that crystallizes in elongated thin, needle-like grains, or fibers.

Table 8. Fibrous

Community	Year	Source	Fibrous
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	Aggregate of slender fibers, parallel or radiating
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	NA
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	When the length is extremely long compared with the width, the crystals are called asbestiform or fibrous.
Mineralogical	2002	http://webmineral.com/help/Fracture.html	[*About fibrous fracture*] Thin, elongated fractures produced by crystal forms or intersecting cleavages (e.g. asbestos).
Mineralogical	2002	http://webmineral.com/help/Habits.html	[*About mineral habit*] Crystals made up of fibers.
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA

Table 8. Fibrous

Community	Year	Source	Fibrous
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	NA
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	...of a mineral composed of parallel, radiating, or interlaced aggregates of fibers, from which the fibers are sometimes separable. That is, the crystalline aggregate may be referred to as fibrous even if it is not composed of separable fibers, but has that distinct appearance. The term fibrous is used in a general mineralogical way to describe aggregates of grains that crystallize in a needle-like habit and appear to be composed of fibers. Fibrous has a much more general meaning than asbestos. While it is correct that all asbestos minerals are fibrous, not all minerals having fibrous habits are asbestos.

Table 8. Fibrous

Community	Year	Source	Fibrous
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	(fibrous structure) A fibre, or connected grouping of fibres, with or without other particles.
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA

Table 9. Parting

Community	Year	Source	Parting
Industrial	1975	Winson, R.W., 1975, Asbestos, *in*, Industrial minerals and rocks (nonmetallics other than fuels): New York, N.Y., American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., p. 379-425.	NA
Industrial	1981	Steel, E. and Wylie, A., 1981, Mineralogical characteristics of asbestos *in* Riordon, P.H. ed, Geology of Asbestos Deposits, Society of Mining Engineers, p. 93-100.	NA
Industrial	1998	Virta, R.L., 2002, Asbestos: U.S. Geological Survey Open File-Report 02-149, 35 p.	NA
Interdisciplinary	1974	Thompson, C.S., 1974, Discussion of the mineralogy of industrial talcs: U.S. Bureau of Mines Information Circular 8639, p. 22-42.	NA
Interdisciplinary	1978	Zoltai, Tibor, 1978, History of asbestos-related mineralogical terminology: National Bureau of Standards Special Publication 506, p. 1-18.	NA
Interdisciplinary	1979	Chatfield, E.J., 1979, Measurement of asbestos fibres in the workplace and in the general environment *in* Ledoux, R.L., Mineralogical techniques of asbestos determination: Mineralogical Association of Canada Short Course, v. 4, p. 111-157.	NA
Interdisciplinary	1980	Dixon, W.C., 1980, Applications of optical microscopy in analysis of asbestos and quartz, *chap 2 of* Dollberg, D.D. and Werstuyft, A.W., eds., Analytical techniques in occupational health chemistry: Washington, D.C., American Chemical Society, p. 13-41.	When a mineral breaks along a plane of structural weakness it exhibits parting.
Interdisciplinary	1980	Clark, R.L., 1982, MSHA standard method for fiber identification by electron microscopy: National Bureau of Standards Special Publication 619, p. 207-210.	NA

Table 9. Parting

Community	Year	Source	Parting
Interdisciplinary	1980	Lee, R.J., Kelly, J.F., and Walker, J.S., 1982, Considerations in the analysis and definition of asbestos using electron microscopy: National Bureau of Standards Special Publication 619, p. 132-137.	NA
Interdisciplinary	1980	Chatfield, E.J. and Lewis, G.M., 1980, Development and application of an analytical technique for measurement of asbestos fibers in vermiculite: Scanning Electron Microscopy, p. 329-340.	NA
Interdisciplinary	1984	National Research Council, 1984, Asbestiform fibers-nonoccupational health risks: Washington D.C., National Academy Press, p. 25-47.	NA
Interdisciplinary	1984	Cossette, M., 1984, Defining asbestos particulates for monitoring purposes *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, p. 5-49.	NA
Interdisciplinary	1984	Ross, M., Kuntze, R.A., and Clifton, R.A., 1984, A definition for asbestos *in* Levadie, B. ed., Definitions for asbestos and other health-related silicates: ASTM Special Technical Publication 834, pp.139-147.	NA
Interdisciplinary	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Interdisciplinary	1990	Mossman, B.T., Bignon, J., Corn, M., Seaton, A., and Gee, J.B.L., 1990, Asbestos-scientific developments and implications for public policy: Science, v. 247, p. 294-301.	NA
Interdisciplinary	2000	The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.	NA

Table 9. Parting

Community	Year	Source	Parting
Interdisciplinary	2000	Wylie, A.G., 2000, The habit of asbestiform amphiboles: implications for the analysis of bulk samples *in* Beard, M.E. and Rooks, H.L, eds., Advances in environmental measurement methods for asbestos: ASTM Special Technical Publication 1342, p. 53-69.	Structural defects produce planes of weakness called parting
Interdisciplinary	2001	Beard, M.E., Crankshaw, O.S., Ennis, J.T., and Moore, C.E., 2001, Analysis of crayons for asbestos and other fibrous materials, and recommendations for improved analytical definitions: Research Triangle Park, North Carolina, Research Triangle Institute, Center for Environmental Measurements and Quality Assurance, Earth and Mineral Sciences Department, [informal report], 23 p., plus appendices A-H.	NA
Interdisciplinary	2001	Nolan, R.P., Langer, A.M., Ross, M., Wicks, F.J., and Martin, R.F., eds., 2001, The health effects of chrysotile asbestos-contribution of science to risk-management decisions: The Canadian Mineralogist Special Publication 5, 304 p.	NA
Medical	1977	Zielhuis, R.L., 1977, Public health risks of exposure to asbestos: Elmsford, N.Y., Pergamon Press Inc., 143 p.	NA
Medical	1979	Langer, A.M., Rohl, A.N., Wolff, M., and Selikoff, I.J., 1979, Asbestos, fibrous minerals and acicular cleavage fragments-Nomenclature and biological properties, *in* Lemen, R. and Dement, J.M., eds., Dust and disease: Park Forest South, Ill., Pathotox Publishers, p. 1-22.	NA

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Community	Year	Source	Parting
Medical	1998	Blake, T., Castranova, V., Schwegler-Berry, D., Baron, P., Deye, G.J., Li, C., and Jones, W., 1998, Effect of fiber length on glass microfiber cytotoxicity: Journal of Toxicology and Environmental Health, v. 54, p. 243-259.	NA
Medical	2001	Ninth Report on Carcinogens, January 2001 http://ehp.niehs.nih.gov/roc/ninth/known/asbestos.pdf	NA
Mineralogical	1914	Dana, E.S., 1914, The system of mineralogy of James Dwight Dana, descriptive mineralogy (6th ed): New York, N.Y., Wiley, p.	...is applied to a separation which is not produced along a plane of minimum cohesion in the lattice but is produced by lamellar twinning, by directed pressure exerted on the crystal, or by oriented inclusions which develop planes of weakness. Parting, in some instances, does not conform to the symmetry requirements of the crystal.
Mineralogical	1977	Campbell, W.J., Blake, R.L, Brown, L.L., Cather, E.E., and Sjober, J.J., 1977, Selected silicate minerals and their asbestiform varieties: U.S. Bureau of Mines Information Circular 8751, 56 p.	The tendency of a crystal or grain to break along crystallographic planes weakened by inclusions or structural defects. Different specimens of the same mineral may or may not exhibit parting. Twinned crystals often part along composition planes, which are lattice planes and therefore, potential crystal faces. Parting is similar to cleavage.
Mineralogical	1979	Campbell, W.J., Steel, E.B., Virta, R.L., and Eisner, M.H., 1979, Relationship of mineral habit to size characteristics for tremolite cleavage fragments and fibers: U.S. Bureau of Mines Report of Investigations 8367, 18 p.	NA
Mineralogical	1980	Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology (2d ed.): Falls Church, Va., American Geological Institute, 749 p.	[crystal] The breaking of a mineral along planes of weakness caused by deformation or twinning; e.g. garnet. Cf: cleavage [mineral].
Mineralogical	1982	MacKenzie, W.S., Donaldson, C.H., and Guilford, C., 1982, Atlas of igneous rocks and their textures: New York, N.Y., Wiley, p. 20.	NA
Mineralogical	1987	Dorling, M. and Zussman, J., 1987, Characteristics of asbestiform and non-asbestiform calcic amphiboles: Lithos, v. 20, p. 469-489.	NA

Table 9. Parting

Community	Year	Source	Parting
Mineralogical	1988	Skinner, H.C., Ross, M., and Frondel, C., 1988, Asbestos and other fibrous materials: New York, N.Y., Oxford, 204 p.	NA
Mineralogical	1993	Klein, C. and Hurlbut, C.S., Jr. ,1993, Manual of mineralogy (after James D. Dana) (21st ed.): New York, N.Y., Wiley, 681 p.	When minerals break along planes of structural weakness. The weakness may result from pressure or twinning or exsolution; and, because it is parallel to rational crystallographic planes, it resembles cleavage.
Mineralogical	1993	Veblen, D.R. and Wylie, A.G., 1993, Mineralogy of amphiboles and 1:1 layer silicates in Guthrie Jr., G.D. and Mossman, B.T., eds., Health effects of mineral dusts: Reviews in Mineralogy, v. 28, p. 61-137,	Parting refers to approximately planar breakage along planes that are not cleavage planes.
Mineralogical	2001	Virta, R.L., 2001, Some facts about asbestos: U.S. Geological Survey Fact Sheet FS-012-01, 4 p.	NA
Mineralogical	2002	http://webmineral.com/help/Fracture.html	NA
Mineralogical	2002	http://webmineral.com/help/Habits.html	NA
Regulatory	1974	U.S. District Court, district of Minnesota, 5th Division. Supplemental Memorandum. No. 5-72, Civil 19, Appendix 5, May 11, 1974, p. 24	NA
Regulatory	1976	National Institute for Occupational Safety and Health, 1976, Revised recommended asbestos standard: DHEW (NIOSH) Publication No. 77-169, 96 p.	NA
Regulatory	1983	29 CFR 1910.1001	NA
Regulatory	1990	Ohio Administrative Code (OAC) 3745-20-01	NA
Regulatory	1992	Crane, D., 1992, Polarized light microscopy of asbestos: Occupational Safety and Health Administration Method # ID-191.	NA
Regulatory	1992	Occupational Safety and Health Administration, 1992, Preambles IV. Mineralogical Considerations, National Stone Association and American Mining Congress	NA

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Community	Year	Source	Parting
Regulatory	1993	Perkins, R.L. and Harvey, B.W., 1993, Method for the determination of asbestos in bulk building materials: U.S. Environmental Protection Agency EPA/600/R-93/116, Office of Research and Development, Washington, D.C.	NA
Regulatory	1993	Occupational Safety and Health Administration, 1993, Better protection against asbestos in the workplace: U.S. Department of Labor Fact Sheet No. OSHA 93-06. Available on the world wide web at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=144	NA
Regulatory	1995	American Society for Testing and Materials, 1995, Standard test method for microvacuum sampling and indirect analysis of dust by transmission electron microscopy for asbestos structure number concentrations: West Conshohocken, Pa., ASTM 5755-95, 13 p.	NA
Regulatory	1995	International Organization for Standardization, 1995, ISO 10312 Ambient air-determination of asbestos fibres-direct-transfer transmission electron microscopy method (1st ed): Geneve, Switzerland, International Organization for Standardization, 51 p.	NA
Regulatory	1996	Colorado Air Quality Control Commission, 1996, Part B-emission standards for asbestos, *excerpted from* Regulation No. 8 "The control of hazardous air pollutants": Colorado Department of Public Health and Environment, 114 p.	NA
Regulatory	1997	Crane, D., 1997, Asbestos in air: Occupational Safety and Health Administration Method # ID-160.	NA

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Community	Year	Source	Parting
Regulatory	1997	NYCRR (New York Code of Rules & Regulations) Title 10 Section 73.1	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools (7-1-01 Edition)	NA
Regulatory	2001	Environmental Protection Agency Part 763-Asbestos Subpart E--Asbestos-Containing Materials in Schools Appendix A (7-1-01 Edition)	NA
Regulatory	2001	29 CFR 1910.1001	NA
Regulatory	2001	30 CFR 56.5001	NA
Regulatory	2001	17 CCR (California Code of Regulations) 93105	NA
Regulatory	2001	West Virginia Code 16-32-2	NA
Regulatory	2002	OAR (Oregon Administrative Rules) 340-248-0010	NA
Regulatory	2002	105 ILCS (Illinois Compiled Statutes Schools) 105/3	NA