1. PUBLIC HEALTH STATEMENT

This public health statement tells you about synthetic vitreous fibers (SVFs) and the effects of exposure to them.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Synthetic vitreous fibers have not been detected in the 1,647 current or former NPL sites. Although the total number of NPL sites evaluated for these substances is not known, the possibility exists that synthetic vitreous fibers may be found in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to these substances may harm you.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to synthetic vitreous fibers, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with them. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT ARE SYNTHETIC VITREOUS FIBERS?

Synthetic vitreous fibers are a group of fibrous inorganic materials that contain aluminum or calcium silicates and other trace oxides and metals, and are made from rock, slag, clay, or glass. These fibers differ from natural mineral fibers such as asbestos because they do not have a crystalline molecular structure. The randomly oriented molecular structure of synthetic vitreous fibers is called an amorphous structure. There are two broad categories of synthetic vitreous

fibers: filaments and wools. The filaments consist of continuous glass filaments, while the wools are subdivided into glass wool, rock wool, slag wool, refractory ceramic fibers, and other types of newer fibers. The primary uses of synthetic vitreous fibers are for heat and sound insulating purposes, to reinforce other materials, and as filtration materials. Glass wools are some of the most widely used insulating materials in homes and buildings. The production and use of synthetic vitreous fibers has increased in recent years because these products are often used as a replacement for asbestos.

A fiber is simply a long, slender particle. Technically, to be counted as a fiber, the particle must be at least 5 micrometers long (1 micrometer equals 1/1,000,000 of a meter and has the symbol μm), and have an aspect ratio of at least 3 to 1 or sometimes 5 to 1 (the aspect ratio is the ratio of a fiber's length to its diameter). The diameter of a fiber is an important property because very thin fibers are more easily suspended in air than thick fibers, and they can be breathed in and deposited deep in the lungs. Only very thin fibers with diameters less than 3 μm are able to be breathed into the lower respiratory tract of humans. Thicker fibers are deposited on the mucous-lined surface of the upper respiratory tract, which includes the nose and mouth. The World Health Organization (WHO) counts respirable fibers as particles with lengths greater than 5 μm, diameters less than 3 μm, and aspect ratios ≥3:1. Depending upon the way that they are produced, fibers can have relatively large or small diameters. Generally speaking, glass wool, rock wool, slag wool, and refractory ceramic fibers have the smallest diameters, while continuous filament glass fibers have the largest diameters.

See Chapters 4 and 5 for more information on the properties and uses of synthetic vitreous fibers.

1.2 WHAT HAPPENS TO SYNTHETIC VITREOUS FIBERS WHEN THEY ENTER THE ENVIRONMENT?

Synthetic vitreous fibers do not evaporate into air or dissolve in water. They are generally not broken down to other compounds in the environment and will remain virtually unchanged over long periods. Eventually, synthetic vitreous fibers will be broken down if the water or soil is very acidic or very alkaline. Fibers can enter the air, water, and soil from the manufacture, use,

and disposal of synthetic vitreous fiber-containing materials. Fibers with small diameters become airborne more easily than thick fibers, and can be transported by wind for longer distances. Synthetic vitreous fibers are not likely to move through soil.

See Chapter 6 for more information on the behavior of synthetic vitreous fibers in the environment.

1.3 HOW MIGHT I BE EXPOSED TO SYNTHETIC VITREOUS FIBERS?

If materials containing synthetic vitreous fibers, such as insulation or ceiling boards in your home or where you work, are disturbed, synthetic vitreous fibers can become airborne. When these fibers become airborne, you can be exposed to low levels of synthetic vitreous fibers primarily by breathing air. Your skin and eyes can also be exposed to synthetic vitreous fibers if you install your own home insulation or come into contact with insulation in your home without using protective equipment such as gloves, protective glasses, or masks.

The vast majority of exposure to synthetic vitreous fibers occurs to workers who produce or use synthetic vitreous fiber-containing products. Employees at manufacturing facilities where synthetic vitreous fibers products are produced, as well as workers who regularly install or come into contact with insulating material, are most frequently exposed to synthetic vitreous fibers. Workers involved in demolition work, as well as in building maintenance and repair, are potentially exposed to higher levels of synthetic vitreous fibers once these materials are disturbed.

See Chapters 3 and 6 for more information on how you could be exposed to synthetic vitreous fibers.

1.4 HOW CAN SYNTHETIC VITREOUS FIBERS ENTER AND LEAVE MY BODY?

If you breathe synthetic vitreous fibers, some will be deposited in the nasal and oral passages, and on the surfaces that line your lungs. Most fibers deposited in the nasal and upper lung airways are removed by being carried away in a layer of mucous to the throat, where they are swallowed into the stomach. This usually takes place within a few hours. Fibers deposited in the deepest parts of the lungs where gas exchange occurs are removed more slowly by special cells called macrophages. Macrophages can engulf the fibers and move them to the mucous layer and the larynx where they can be swallowed. Swallowed fibers and macrophages are excreted in the feces within a few days.

Synthetic vitreous fibers deposited in the gas exchange area of the lungs also slowly dissolve in lung fluid. Fibers that are partially dissolved in lung fluid are more easily broken into shorter fibers. Shorter fibers are more easily engulfed by macrophages and removed from the lung than long fibers. Synthetic vitreous fibers dissolve more readily in the lung than asbestos fibers. Refractory ceramic fibers dissolve more slowly than most types of insulation (e.g., glass wools, stone wools, and slag wools).

If you swallow synthetic vitreous fibers (by eating, drinking, or by swallowing fibers that have moved from nasal or lung airways to your larynx), nearly all of the fibers pass through your intestines within a few days and are excreted in the feces.

If you get synthetic vitreous fibers on your skin or in your eyes, very few of these fibers, if any, pass through into your body.

See Chapter 3 for more information on how synthetic vitreous fibers enter and leaves the body.

1.5 HOW CAN SYNTHETIC VITREOUS FIBERS AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make informed decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Synthetic vitreous fibers can cause irritation of the eyes and skin known as "fiberglass itch." They can also irritate the upper respiratory tract (the nose, throat) and parts of the lung, causing sore throat, nasal congestion, and cough. These effects usually go away with time. Because most people are not exposed to high levels of synthetic vitreous fibers, serious health effects are not expected to happen in most people.

Most of the information regarding the possible effects of repeated exposure to synthetic vitreous fibers in people comes from large studies of workers who make synthetic vitreous fibers. Very few effects were detected. A few workers who made refractory ceramic fibers had pleural plaques on the lining of their chests. These plaques did not seem to harm the workers. Other workers who smoked could not breathe quite as well as smokers who did not work with refractory ceramic fibers. Nonsmoking refractory ceramic fiber workers could breathe as well as other nonsmokers. This suggests that repeatedly breathing in refractory ceramic fibers from workplace air worsens the effects of smoking. Pleural plaques and decreased breathing ability have not been found in workers who made glass wool and stone wool. Other studies have found that the numbers of deaths from lung diseases, including lung cancer or mesothelioma, in groups of workers involved in the manufacture of glass wool, stone wool, or refractory ceramic fibers are not consistently different from what is found in the general U.S. population. Mesothelioma is

a cancer of the membrane lining the lung. Increased risk for mesothelioma has been found in asbestos workers, but increased risks for this cancer have not been found in workers involved in the manufacture of synthetic vitreous fibers.

Results from animal experiments show that when synthetic vitreous fibers or other inhaled dust particles are deposited in the deepest part of the lung in high numbers, the lung responds with a process called pulmonary inflammation. In this process, macrophage numbers in the lung increase so that they can engulf and move the fibers out of the lung. When high numbers of fibers are deposited, the macrophages can become clumped together. If pulmonary inflammation continues, the cells lining the lung may thicken from a process called bronchiolization. Bronchiolization may reduce the amount of oxygen that the body gets from the air during breathing. If exposure stops, deposited synthetic vitreous fibers slowly dissolve in the lung fluid or are moved out of the lung by the macrophages, and pulmonary inflammation disappears with time.

Results from animal studies also show that repeatedly breathing high levels of some types of synthetic vitreous fibers may cause a slow buildup of scar-like tissue in the lungs and in the membrane surrounding the lungs. This scar-like tissue does not expand and contract like normal lung tissue, and breathing can become difficult. This condition is called pulmonary fibrosis. The types of synthetic vitreous fibers that cause this condition in animals stay in the lung for longer periods of time than the types that do not. They are called durable or biopersistent synthetic vitreous fibers. Results from animal studies also show that repeatedly breathing high levels of durable synthetic vitreous fibers may also cause cancer of the lung and mesothelioma. The most common types of glass wools, stone wools, or slag wools used for insulation are less durable than refractory ceramic fibers. In rat studies, they did not cause the severe lung effects caused by the more durable refractory ceramic fibers.

Scientists studying pulmonary fibrosis, lung cancer, and mesothelioma in animals from durable synthetic vitreous fibers have shown that the development of these conditions depends on four factors: dose, duration, dimension, and durability. Dose is the amount of fibers deposited in the lung, and duration is the time period when exposure occurs. High doses and long durations of

exposure are required for these conditions to develop. Dimension refers to the length and diameter of the fibers. Fibers with diameters greater than about 3 μm are not inhaled into the deepest regions of the lungs. Fibers with lengths greater than about 15–20 μm are not engulfed by macrophages, and are more likely to lead to lung injury than shorter fibers that are more readily removed by macrophages. Durability refers to how readily a fiber dissolves in lung fluid. Different types of synthetic vitreous fibers have different durabilities due to differences in chemical makeup. Most synthetic vitreous fibers used as insulation in homes and buildings, such as fiberglass wools and stone wools, are more readily dissolved in lung fluid than are refractory ceramic fibers, which are used in insulation materials for furnaces. Long, durable fibers deposited in the gas-exchange region of the lung can lead to long-term inflammation, pulmonary fibrosis, lung cancer, or mesothelioma.

Levels of synthetic vitreous fibers in outdoor air, indoor air, and in most workplaces are usually well below levels that caused reversible pulmonary inflammation in animals or levels of durable synthetic vitreous fibers that caused pulmonary fibrosis, lung cancer, or mesothelioma in animals. For example, levels of a refractory ceramic fiber that caused pulmonary fibrosis, lung cancer, and mesothelioma in rats are about one million times higher than levels of synthetic vitreous fibers detected in outdoor air close to synthetic vitreous fiber manufacturing factories, or indoor air from buildings with fiberglass or stone wool insulation. The levels experienced by the diseased rats are about 50 times higher than levels of synthetic vitreous fibers in the most dusty workplaces where insulation containing synthetic vitreous fibers was removed or installed.

In 2002, the International Agency for Research on Cancer (IARC) considered all of the evidence regarding the possible carcinogenicity of synthetic vitreous fibers. Much of the evidence was collected in the 1990s and was not available for earlier assessments made by the U.S. Department of Health and Human Services (DHHS). IARC determined that refractory ceramic fibers are possibly carcinogenic to humans because of their high biopersistence. IARC also determined that insulation glass wool, stone wool, and slag wool, and continuous filament glass were not classifiable as to carcinogenicity to humans because of inadequate evidence of carcinogenicity in humans and the relatively low biopersistence of these materials. EPA has not

assessed the potential carcinogenicity of glass wool, stone wool, slag wool, or continuous filament glass, but has classified refractory ceramic fibers as a probable human carcinogen.

See Chapters 2 and 3 for more information on how synthetic vitreous fibers may affect your health.

1.6 HOW CAN SYNTHETIC VITREOUS FIBERS AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Because synthetic vitreous fibers are not absorbed into the body (when inhaled or ingested), it is unlikely that they would cause birth defects or be transferred in breast milk to nursing infants.

Like adults, children who are exposed to synthetic vitreous fibers may experience irritation of the eyes, skin, and upper respiratory tract. Children breathe differently and have different lung structures than do adults. It is not likely that these differences will cause a greater amount of synthetic vitreous fibers to stay in the lungs of children than in the lungs of adults.

It is possible that exposure of young children to highly durable fibers could lead to pulmonary effects after very long latency periods. However, there is no evidence to support this possibility, and the durability of many types of synthetic vitreous fibers in the lung is low. This concern also has been raised for children exposed to asbestos fibers, which are more durable than synthetic vitreous fibers, but, as with synthetic vitreous fibers, there is inadequate evidence to support the idea that exposed young children may be at greater risk to develop pulmonary effects from durable fibers than are adults.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO SYNTHETIC VITREOUS FIBERS?

If your doctor finds that you have been exposed to significant amounts of synthetic vitreous fibers, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

Very low levels of synthetic vitreous fibers can be found in virtually all homes, buildings, and outside air, but there is little concern regarding these low levels. The most important way that families can lower their exposures to synthetic vitreous fibers is to be aware of the sources of synthetic vitreous fibers in their homes and avoid exposure to these sources. The most common source of synthetic vitreous fibers in a home is from insulating material that may be in your attic or walls. Damaged or deteriorating ceiling boards are another potential source. As long as the materials are not physically disturbed or breaking down, the levels of synthetic vitreous fibers in the air should be very low. Relatively high levels of airborne synthetic vitreous fibers have been detected during the installation of insulating materials in attics, but these levels decline rapidly in 1 or 2 days as airborne dust settles. If you are installing your own insulation, wear protective clothing and masks, and follow the recommendations provided by the manufacturer for installing this material.

You can bring synthetic vitreous fibers home in the dust on your hands or clothes if you work in facilities that produce or use synthetic vitreous fibers, or install or remove materials with synthetic vitreous fibers. Your occupational health and safety (OHS) officer can and should tell you whether chemicals you work with are dangerous and likely to be carried home on your clothes, body, or tools. Your OHS officer can also tell you whether you should be showering and changing clothes before you leave work, storing your street clothes in a separate area of the workplace, or laundering your work clothes at home separately from other clothes. Your employer should have Material Safety Data Sheets (MSDSs) for many of the chemicals used at your place of work, as required by the Occupational Safety and Health Administration (OSHA). Information on these sheets should include chemical names and hazardous ingredients, important properties (such as fire and explosion data), potential health effects, how you get the chemical(s)

in your body, how to handle the materials properly, and what to do in an emergency. Your employer is legally responsible for providing a safe workplace and should freely answer your questions about hazardous chemicals. Either OSHA or your OSHA-approved state occupational safety and health program can answer any further questions and help your employer identify and correct problems with hazardous substances. OSHA or your OSHA-approved state occupational safety and health program will listen to your formal complaints about workplace health hazards and inspect your workplace when necessary. Employees have a right to safety and health on the job without fear of punishment.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO SYNTHETIC VITREOUS FIBERS?

No tests are specific for determining whether or not you have been exposed to synthetic vitreous fibers. Because synthetic vitreous fibers leave the body quickly, most nonspecific tests would not be very useful. A chest x-ray is a common method to determine if you have certain conditions, such as pleural plaques, lung or pleural fibrosis, lung tumors, or mesotheliomas, but x-rays cannot show the presence of fibers in the lung.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; they are then adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for synthetic vitreous fibers include the following:

In 1999, a Health and Safety Partnership Program was established as a voluntary workplace safety program for workers involved in the manufacture, fabrication, installation, and removal of glass wool, rock wool, and slag wool products. The program was established as a result of negotiations between the OSHA, the North American Insulation Manufacturers Association, the National Insulation Association, and the Insulation Contractors Association of America. The program established a voluntary 8-hour time-weighted average (TWA) permissible exposure limit (PEL) of 1 respirable fiber per cc of air. Under this agreement, respirable fibers are counted as particles with length greater than 5 μm, diameter less than 3 μm, and aspect ratio greater than or equal to 3:1. The agreement specifies that when the PEL is exceeded in a workplace (such as when insulation is blown into attics or removed), workers will wear NIOSH certified dust respirators.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the information and technical assistance toll-free number at 1-888-42ATSDR (1-888-422-8737), by email at atsdric@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations may request a copy of final profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: http://www.ntis.gov/