

1. PUBLIC HEALTH STATEMENT

This public health statement summarizes general information about tungsten and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Tungsten has been found in at least 6 of the 1,636 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which tungsten is found may increase. This information is important because these sites may be sources of exposure.

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 tungsten, 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 it. 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 IS TUNGSTEN?

Tungsten is a naturally occurring element that, in most environments, is a solid. In nature, it occurs in rocks and soil as minerals, but never as the pure metal. Two kinds of tungsten-bearing mineral rocks, called wolframite and scheelite, are mined commercially. The mineral ore is processed to recover the tungsten and turn it into either chemical compounds or metal.

Elemental tungsten, like elemental copper or gold, is a metal. Its color can range from tin white (for the pure metal) to steel gray (for metal that has impurities in it). Tungsten can be used as a pure metal or mixed with other metals to make alloys. Tungsten alloys tend to be strong and

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flexible, resist wear, and conduct electricity well. Tungsten and its alloys are used as light bulb filaments, as the part of x-ray tubes where x-rays are formed, as a catalyst to speed up chemical reactions, as a component of steel in high-speed tools, in phonographic needles, as welding electrodes, and as gyroscope wheels. They can be used in bullets (as a replacement for lead) and in armor penetrators (as a substitute for depleted uranium). Chemical compounds of tungsten are used for many purposes. Cemented tungsten carbide, a hard substance used to make grinding wheels and cutting or forming tools, is the most common tungsten compound. Other tungsten compounds are used in ceramic pigments, as fire retardant coatings for fabrics, and as color-resistant dyes for fabrics. More information on the chemical, physical properties, production, and uses of tungsten and its compounds are presented in Chapters 4, 5, and 6.

1.2 WHAT HAPPENS TO TUNGSTEN WHEN IT ENTERS THE ENVIRONMENT?

Tungsten occurs naturally in the environment, in minerals, but not as the pure metal. As an element, tungsten can be neither created nor destroyed chemically, although tungsten can change forms in the environment.

Tungsten is released into air as fine dust-like particles by weathering. Emissions from hard metal industries also increase tungsten levels in air. The amount of tungsten that has been measured in the ambient air is, in general, less than 10 billionths of a gram per cubic meter (or parts per billion [ppb]). Very small dust particles of tungsten in the air fall out onto surface water, plant surfaces, and soil either by themselves or when rain or snow falls. These tungsten particles eventually recycle back in the soil or in the bottoms of lakes, rivers, and ponds, where they stay and mix with tungsten that is already there.

Tungsten in water originates mainly from dissolution of tungsten from rocks and soil that water runs over and through. Tungsten has not been detected in the vast majority of surface water and groundwaters of the United States. Some exceptions include areas near mines and natural deposits, and also in Fallon, Nevada, where tungsten has been detected in municipal water and groundwater. Only a very small fraction of tungsten in water originates from the settling of dust out of the air. Most tungsten products of human-origin that enter waterways originate from industry discharges of waste water. Tungsten in water may be in either soluble or insoluble

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forms. Insoluble tungsten in water can settle to the bottom where it enters sediment. Some insoluble tungsten compounds, however, can remain suspended in ocean water for many years, requiring as long as 1,000 years to settle to the bottom.

Tungsten occurs naturally in soil as a mineral, or component of soil. It occurs in amounts that vary over a wide range from less than 1 to as high as 83 thousandths of a gram per kilogram of soil. Another way to say this is that the soil concentration ranges from 1 to 83 parts per million (ppm). Disposal of coal ash, incinerator ash, and industrial wastes may increase the amount of tungsten in soil. A portion of tungsten in soil does not dissolve in water, but remains bound and is not likely to move deeper into the ground and enter groundwater. The remaining soluble portion may move deeper into the ground and enter groundwater if the pH is greater than 7. In the environment, chemical reactions can change the water-soluble tungsten compounds into insoluble forms. In some cases, water-insoluble tungsten compounds can change to soluble forms. In general, exposure to water-soluble tungsten compounds in the environment will pose a greater threat to human health than water-insoluble forms. More information about the fate and movement of tungsten in the environment is presented in Chapter 6.

1.3 HOW MIGHT I BE EXPOSED TO TUNGSTEN?

You can be exposed to low levels of tungsten by breathing air or eating food that contains tungsten. The average ambient concentration of tungsten in air has been reported to be less than 0.5 nanograms in a cubic meter of air (1 nanogram is 1 billionth of a gram). Cities have higher levels of tungsten in the air because tungsten is released from industry. Tungsten has been detected in municipal water from Fallon, Nevada. However, the amounts of tungsten in drinking water are generally not known. This is probably because the tungsten levels are lower than the laboratory methods are able to detect without concentrating samples, or the laboratory does not measure for tungsten. The amounts in foods are generally not known, possibly for the same reasons. For residents of the European Community, beverages significantly contributed to the total dietary intake of tungsten. The average concentration of tungsten in beverages ranged from 0.31 to 7.4 micrograms per liter of water (1 microgram is 1 millionth of a gram). Tungsten in plants was either taken up by the plant or was attached to the plant as a component of the soil. The concentration of tungsten in onions collected from Denmark is 17 micrograms in a kilogram

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of fresh vegetables. Although very limited data are available, exposure to tungsten from air, drinking water, and food is expected to be insignificant.

In certain workplaces, you can be exposed to levels of tungsten in air that are higher than background levels, which are very small or none. Exposures are mostly in the form of tungsten metal or tungsten carbide. Occupational exposure to tungsten occurs primarily at places where individuals use hard metals containing tungsten or are engaged in the machining of these metals. This includes the grinding (pointing) of tungsten metal welding electrodes prior to use. Occupational exposure to tungsten carbide occurs during the machining of tungsten carbide tools in the manufacturing process. The total number of individuals occupationally exposed to tungsten or its compounds has been estimated to be about 68,000.

Tungsten metal and metal alloys occur in consumer products such as electronics, light bulbs filaments, cemented tungsten carbide grinding wheels, carbide tipped tools, and “green” bullets. No other consumer products or products used in crafts, hobbies, or cottage industries were identified that contain significant amounts of tungsten. It is unlikely that tungsten present in consumer products poses a hazard. However, appropriate dust masks are recommended for amateur craftsmen engaging in activities that may potentially produce tungsten carbide dust (e.g., metal grinding). More information about tungsten exposure is discussed in Chapter 6.

1.4 HOW CAN TUNGSTEN ENTER AND LEAVE MY BODY?

Tungsten can enter your body from the food you eat or the water you drink, from the air you breathe, or from contact with the skin. When you eat, drink, breathe, or touch things containing tungsten compounds that can easily be dissolved in water, tungsten enters your blood and is carried to all parts of your body. Most of the tungsten that enters your blood is rapidly released from your body in the urine. When you eat or drink things containing tungsten, much of the tungsten passes through your digestive system and is released from your body in the feces. When you breathe air that contains tungsten, some of the tungsten moves quickly to your bloodstream from the lungs, and some of the tungsten is cleared from your lungs in mucus that is either swallowed or spit out. When you swallow tungsten that was first in your lungs, it passes through your digestive system as if you had eaten it. Some enters your blood from your

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digestive system and some passes out with the feces. A small portion of the tungsten that enters your blood may spend some time in bone, fingernails, or hair. Some of this tungsten is slowly eliminated from your body through the urine and feces.

1.5 HOW CAN TUNGSTEN 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 wise 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.

You are not likely to experience any health effects that would be related to exposure to tungsten or tungsten compounds. Tungsten compounds have caused breathing problems and changed behavior in some animals given very large amounts of tungsten compounds, but you are not likely to be exposed to amounts of tungsten in the air you breathe or the food or water you take into your body that would be large enough to cause similar effects.

1.6 HOW CAN TUNGSTEN AFFECT CHILDREN?

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

Children could be affected in the same ways as adults. In adult animals, very large amounts of tungsten compounds have been shown to cause breathing problems and changes in behavior. However, it is not likely that children would be exposed to amounts of tungsten in the air they

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breathe or the food or water they consume that would be large enough to cause effects similar to those that were seen in the animals. Animal studies have shown that tungsten in the blood of a pregnant mother can enter the blood of a fetus in the womb. Studies in dairy cows have shown that tungsten may also enter the milk. There is no information to suggest that the effects seen in animals could not occur in humans. We do not know whether unborn babies, babies, and children might differ from adults in their susceptibility to health effects from exposure to tungsten or tungsten compounds.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO TUNGSTEN?

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

Children living near waste sites containing tungsten are likely to be exposed to higher environmental levels of tungsten through breathing, drinking contaminated drinking water, touching soil, and eating contaminated soil. Children sometimes eat dirt, which should be discouraged. Parents should supervise to see that children wash their hands frequently and before eating. Parents should consult their family physicians about whether (and how) hand-to-mouth behaviors in their children might be discouraged. If your community's drinking water has been reported to contain elevated levels of tungsten, you should take advantage of alternative water sources such as bottled water for drinking. Some children may be exposed to tungsten by contact with a family member who works in a facility using tungsten or who works with tungsten carbide grinding wheels. If you work at a facility that uses tungsten or have tungsten dust on your clothes, change your clothes and clean your hair and skin before leaving your job or work site and returning home. Do not bring objects home such as work tools that may be contaminated with tungsten.

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1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO TUNGSTEN?

Medical tests exist that can determine whether your body fluids contain high levels of tungsten. Samples of blood or feces can be collected in a doctor's office and sent to a laboratory that can measure tungsten levels. It is easier for most laboratories to measure tungsten in blood than in feces. The presence of high levels of tungsten in the feces can mean recent high tungsten exposure. High levels of tungsten in the blood can mean high tungsten consumption and/or high exposure. High tungsten levels in blood or feces reflect the level of exposure to tungsten. Measuring tungsten levels in urine and saliva also may provide information about tungsten exposure. Tests to measure tungsten in hair may provide information on long-term tungsten exposure. More information on tests to measure tungsten in the body is located in Chapter 7.

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; then they are 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.

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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 tungsten include the following:

There are few guidelines for tungsten and tungsten compounds. For tungsten and insoluble tungsten compounds, NIOSH has established a recommended exposure limit (REL; 10-hour time weighted average) of 5 mg/m³ and a short-term exposure limit (STEL; 15-minute time weighted average) of 10 mg/m³. OSHA has established permissible exposure limits (PELs; 8-hour time weighted average) for tungsten of 5 mg/m³ (insoluble compounds) and 1 mg/m³ (soluble compounds) for construction and shipyard industries.

More information on regulations and guidelines is available in Chapter 8.

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 at:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop E-29
Atlanta, GA 30333
Fax: 1-404-498-0093

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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/>