

## 1. PUBLIC HEALTH STATEMENT

This public health statement tells you about vanadium and the effects of exposure to it.

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. Vanadium has been found in at least 319 of the 1,699 current or former NPL sites. Although the total number of NPL sites evaluated for this substance is not known, the possibility exists that the number of sites at which vanadium is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to this substance may be harmful.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be 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 vanadium, many factors will determine whether you will 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 any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

### 1.1 WHAT IS VANADIUM?

<b>Description</b>	Vanadium is a naturally occurring element. It is widely distributed in the earth's crust at an average concentration of approximately 100 mg/kg. Vanadium is found in about 65 different minerals.  Depending on its form, vanadium can be a gray-white metal or light gray or white lustrous powder. Pure vanadium is a bright white, soft, and ductile metal.
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<p><b>Uses</b></p> <ul style="list-style-type: none"> <li>• <b>Vanadium metal</b></li>   <li>• <b>Vanadium pentoxide</b></li>   <li>• <b>Vanadyl sulfate and sodium metavanadate</b></li> </ul>	<p>Vanadium is used in producing rust-resistant, spring, and high-speed tool steels. It is an important carbide stabilizer in making steels.</p> <p>Vanadium pentoxide is used in ceramics and as a catalyst as well as in the production of superconductive magnets.</p> <p>Vanadyl sulfate and sodium metavanadate have been used in dietary supplements.</p>
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For more information on the physical and chemical properties of vanadium and its production, disposal and use, see Chapters 4 and 5.

## 1.2 WHAT HAPPENS TO VANADIUM WHEN IT ENTERS THE ENVIRONMENT?

<p><b>Sources</b></p>	<p>Vanadium occurs naturally in soil, water, and air. Natural sources of atmospheric vanadium include continental dust, marine aerosol, and volcanic emissions.</p> <p>Releases of vanadium to the environment are mainly associated with industrial sources, especially oil refineries and power plants using vanadium rich fuel oil and coal. Global human-made atmospheric releases of vanadium have been estimated to be greater than vanadium releases due to natural sources. Natural releases to water and soil are far greater overall than human-made releases to the atmosphere.</p>
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<p><b>Break down</b></p> <ul style="list-style-type: none"><li>• <b>Air</b></li> <li>• <b>Water and soil</b></li></ul>	<p>Vanadium cannot be destroyed in the environment. It can only change its form or become attached or separated from airborne particulate, soil, particulate in water, and sediment.</p> <p>Vanadium particles in the air settle to the ground or are washed out of the air by rain. Smaller particles, such as those emitted from oil-fueled power plants, may stay in the air for longer times and are more likely to be transported farther away from the site of release.</p> <p>The transport and partitioning of vanadium in water and soil is influenced by many factors including acidity of the water or soil and the presence of particulates. Vanadium can either be dissolved in water as ions or may become adsorbed to particulate matter.</p>
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## 1.3 HOW MIGHT I BE EXPOSED TO VANADIUM?

<b>Food—primary source of exposure</b>	<p>Most foods have naturally occurring low concentrations of vanadium. Seafood generally contains higher concentrations of vanadium than meat from land animals.</p> <p>Daily intakes of vanadium from food ranging from 0.01 to 0.02 mg have been reported. Average vanadium concentrations in tap water are approximately 0.001 mg/L. Assuming that you drink approximately 2 L of water a day, a daily intake of approximately 0.002 mg of vanadium from tap water can be estimated for adults.</p> <p>Vanadium also may be found in various commercial nutritional supplements and multivitamins in amounts ranging from 0.0004 to 12.5 mg, depending on the serving size recommended by the manufacturer. Consumption of some vanadium-containing supplements may result in intakes of vanadium that would exceed intakes from food and water.</p> <p>Populations in areas with high levels of residual fuel oil consumption may also be exposed to above-background levels of vanadium, from increased particulate deposition upon food crops and soil in the vicinity of power plants.</p>
<b>Air</b>	<p>Most people take in very little vanadium from breathing. The general population may also be exposed to airborne vanadium through inhalation, particularly in areas where a large number of oil fired power plants are using residual fuel oils for energy production.</p> <p>Individuals exposed to cigarette smoke may also be exposed to higher than background levels of vanadium. Approximately 0.0004 mg of vanadium is released in the smoke of one cigarette.</p>
<b>Water and soil</b>	<p>Vanadium concentrations in surface water can range from approximately 0.04 to 220 µg/L depending on geographical location.</p>

For more information on how you might be exposed to vanadium, see Chapter 6.

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**1.4 HOW CAN VANADIUM ENTER AND LEAVE MY BODY?**

<p><b>Enter your body</b></p> <ul style="list-style-type: none"> <li>• <b>Inhalation</b></li>   <li>• <b>Ingestion</b></li>   <li>• <b>Dermal contact</b></li> </ul>	<p>Some of the vanadium you breathe will enter your body through your lungs; however, we do not know how much will enter.</p> <p>A small amount of vanadium in food and water (3–20%) will enter your body through the digestive tract. The vanadium compounds you are exposed to will determine how much is absorbed.</p> <p>We do not know how much vanadium will enter your body through your skin. It is likely that very little will pass through the skin.</p>
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For more information about how vanadium enters and leaves your body, see Chapter 3.

**1.5 HOW CAN VANADIUM AFFECT MY HEALTH?**

This section looks at studies concerning potential health effects in animal and human studies.

<p><b>Workers</b></p> <ul style="list-style-type: none"> <li>• <b>Inhalation</b></li> </ul>	<p>Breathing air with vanadium pentoxide can result in coughing which can last a number of days after exposure.</p>
<p><b>Laboratory animals</b></p> <ul style="list-style-type: none"> <li>• <b>Inhalation</b></li> </ul>	<p>Damage to the lungs, throat, and nose have been observed in rats and mice exposed to vanadium pentoxide.</p>
<p><b>Humans</b></p> <ul style="list-style-type: none"> <li>• <b>Oral</b></li> </ul>	<p>Nausea, mild diarrhea, and stomach cramps have been reported in people taking sodium metavanadate or vanadyl sulfate for the experimental treatment of diabetes.</p> <p>Stomach cramps were also reported in a study of people taking about 13 mg vanadium/day.</p>

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<b>Laboratory animals</b> <ul style="list-style-type: none"> <li>• Oral</li> </ul>	A number of effects have been found in rats and mice ingesting several vanadium compounds. The effects include: <ul style="list-style-type: none"> <li>• Decreases in number of red blood cells</li> <li>• Increased blood pressure</li> <li>• Mild neurological effects</li> <li>• Developmental effects in animals</li> </ul>
<b>Cancer</b>	Lung cancer has been found in mice exposed to vanadium pentoxide.  The International Agency for Research on Cancer (IARC) has determined that vanadium is possibly carcinogenic to humans.

For more information on health effects in people and animals after breathing, eating, or touching vanadium, see Chapter 3.

## 1.6 HOW CAN VANADIUM AFFECT CHILDREN?

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

<b>Effects in children</b>	The health effects seen in children from exposure to toxic levels of vanadium are expected to be similar to the effects seen in adults. We do not know if children will be more sensitive to vanadium toxicity than adults.
<b>Birth defects</b>	We do not know whether vanadium can cause birth defects in people.  Studies in animals exposed during pregnancy have shown that vanadium can cause decreases in growth and increases in the occurrence of birth defects. These effects are usually observed at levels which cause effects in the mother. Effects have also been observed at vanadium doses which did not cause effects in the mother.

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**1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO VANADIUM?**

<b>Food</b>	<p>Vanadium is a naturally occurring element that is widely distributed in the environment. It is found in many foods, typically in small amounts. You cannot avoid exposure to vanadium.</p> <p>Exposure to the levels of vanadium that are naturally present in food and water are not considered to be harmful.</p>
<b>Consumer products</b>	<p>Consumption of some vanadium-containing supplements may result in intakes of vanadium that would exceed intakes from food and water. You should check with your physician before taking supplements containing vanadium to determine if such supplements are appropriate for you.</p> <p>As a precaution, such products should have child-proof caps or should be kept out of reach of children so that children will not accidentally ingest them.</p>
<b>Air</b>	<p>Individuals exposed to cigarette smoke may also be exposed to higher-than-background levels of vanadium. Avoiding exposure to cigarette smoke may reduce exposure of you and your family to vanadium.</p> <p>To limit exposure to vanadium particles in the air, use a wet mop on non-carpeted floors, use a wet rag instead of a dry rag or duster to dust, vacuum your carpet often using a vacuum with a high-efficiency HEPA filter, and keep windows and doors closed on windy days.</p>

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

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

<b>Detecting exposure</b>	All people have small amounts of vanadium in their bodies. It can be measured in blood, urine, and hair. Measurement of vanadium levels require special methods and equipment, which can be found in a specialized clinical laboratory.
<b>Measuring exposure</b>	<p>Measurements of vanadium concentrations in blood and urine can tell you whether you have been exposed to larger-than-normal amounts of vanadium. Blood and urinary vanadium levels are considered the most reliable indicators of occupational exposure to vanadium.</p> <p>Measuring vanadium levels in hair is not a good indicator of occupational or environmental exposure to vanadium.</p>

For more information on ways to tell whether you have been exposed to vanadium see Chapters 3 and 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. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but cannot be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances.

Regulations and recommendations can be expressed as “not-to-exceed” levels. These are levels of a toxic substance in air, water, soil, or food that do not exceed a critical value. This critical value is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it.



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Some regulations and recommendations for vanadium include the following:

<b>Workplace air</b>	OSHA set a legal limit of 0.5 mg/m <sup>3</sup> for vanadium pentoxide respirable dust as a ceiling not to be exceeded during the work day. A ceiling limit of 0.1 mg/m <sup>3</sup> for vanadium pentoxide fume has also been established.
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**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 that result from exposure to hazardous substances.

Toxicological profiles are also available on-line at [www.atsdr.cdc.gov](http://www.atsdr.cdc.gov) and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636), by e-mail at [cdcinfo@cdc.gov](mailto:cdcinfo@cdc.gov), or by writing to:

Agency for Toxic Substances and Disease Registry  
Division of Toxicology and Human Health Sciences (proposed)  
1600 Clifton Road NE  
Mailstop F-62  
Atlanta, GA 30333  
Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological 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/>