



# PUBLIC HEALTH STATEMENT

## Styrene

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**Division of Toxicology and Human Health Sciences (proposed)**

**June 2012**

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This Public Health Statement is the summary chapter from the Toxicological Profile for Styrene. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-800-232-4636.

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This public health statement tells you about styrene 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. Styrene has been found in at least 251 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 styrene 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 harm you.

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 styrene, 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.

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### 1.1 WHAT IS STYRENE?

<b>Description</b>	<p>Styrene is a colorless liquid that evaporates easily.</p> <p>In its pure form, styrene has a sweet smell. Manufactured styrene may contain aldehydes, which give it a sharp, unpleasant odor.</p>
<b>Uses</b>	
• <b>manufacturing</b>	<p>Large amounts of styrene are produced in the United States. Small amounts are produced naturally by plants, bacteria, and fungi. Styrene is also present in combustion products such as cigarette smoke and automobile exhaust.</p>
• <b>consumer products</b>	<p>Styrene is widely used to make plastics and rubber. Consumer products containing styrene include:</p> <ul style="list-style-type: none"><li>• packaging materials</li><li>• insulation for electrical uses (i.e., wiring and appliances)</li><li>• insulation for homes and other buildings</li><li>• fiberglass, plastic pipes, automobile parts</li><li>• drinking cups and other "food-use" items</li><li>• carpet backing</li></ul> <p>These products mainly contain styrene linked together in long chains (polystyrene). However, most of these products also contain a small amount of unlinked styrene.</p>

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

<b>Sources</b>	<p>Styrene can be found in air, soil, and water after release from the manufacture, use, and disposal of styrene-based products.</p>
<b>Break down</b>	
• <b>Air</b>	<p>Styrene is quickly broken down in the air, usually within 1–2 days.</p>
• <b>Water and soil</b>	<p>Styrene evaporates from shallow soils and surface water. Styrene that remains in soil or water may be broken down by bacteria or other microorganisms.</p>

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### 1.3 HOW MIGHT I BE EXPOSED TO STYRENE?

<b>Air</b>	<p>The primary way you can be exposed to styrene is by breathing air containing it. Releases of styrene into the air occur from:</p> <ul style="list-style-type: none"><li>• industries using or manufacturing styrene</li><li>• automobile exhaust</li><li>• cigarette smoke, and</li><li>• use of photocopiers</li></ul> <p>Rural or suburban air generally contains lower concentrations of styrene than urban air. Indoor air often contains higher levels of styrene than outdoor air.</p> <ul style="list-style-type: none"><li>• 0.06–4.6 parts per billion (ppb) in outdoor air</li><li>• 0.07–11.5 ppb in indoor air</li></ul>
<b>Water and soil</b>	<p>Styrene is occasionally detected in groundwater, drinking water, or soil samples. Drinking water containing styrene or bathing in water containing styrene may expose you to low levels of this chemical.</p>
<b>Workplace air</b>	<p>A large number of workers are potentially exposed to styrene. The highest potential exposure occurs in the reinforced-plastics industry, where workers may be exposed to high air concentrations and also have dermal exposure to liquid styrene or resins.</p> <p>Workers involved in styrene polymerization, rubber manufacturing, and styrene-polyester resin facilities and workers at photocopy centers may also be exposed to styrene.</p>
<b>Food</b>	<p>Low levels of styrene occur naturally in a variety of foods, such as fruits, vegetables, nuts, beverages, and meats. Small amounts of styrene can be transferred to food from styrene-based packaging material.</p>

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### 1.4 HOW CAN STYRENE ENTER AND LEAVE MY BODY?

<b>Enter your body</b> <ul style="list-style-type: none"><li>• <b>Inhalation</b></li></ul>	When you breathe air containing styrene, most of the styrene will rapidly enter your body through your lungs.
<ul style="list-style-type: none"><li>• <b>Ingestion</b></li></ul>	Styrene in food or water may also rapidly enter your body through the digestive tract.
<ul style="list-style-type: none"><li>• <b>Dermal contact</b></li></ul>	A very small amount may enter through your skin when you come into contact with liquids containing styrene.
<b>Leave your body</b>	Once in your body, styrene is broken down into other chemicals. Most of these other chemicals leave your body in the urine within few days.

### 1.5 HOW CAN STYRENE AFFECT MY HEALTH?

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

<b>Workers</b> <ul style="list-style-type: none"><li>• <b>Inhalation</b></li></ul>	<p>The most common health problems in workers exposed to styrene involve the nervous system. These health effects include changes in color vision, tiredness, feeling drunk, slowed reaction time, concentration problems, and balance problems.</p> <p>The styrene concentrations that cause these effects are more than 1,000 times higher than the levels normally found in the environment.</p>
<b>Laboratory animals</b> <ul style="list-style-type: none"><li>• <b>Inhalation</b></li></ul>	<p>Hearing loss has been observed in animals exposed to very high concentrations of styrene.</p> <p>Animal studies have shown that inhalation of styrene can result in changes in the lining of the nose and damage to the liver. However, animals may be more sensitive than humans to the nose and liver effects.</p>

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<b>Laboratory animals</b> • Oral	Impaired learning has been observed in rats exposed to high doses of styrene.  Sperm damage has also been observed in rats exposed to high doses of styrene.
<b>Cancer</b>	The Department of Health and Human Services (DHHS), National Toxicology Program (NTP) listed styrene as "reasonably anticipated to be a human carcinogen" in the Report on Carcinogens, Twelfth Edition, released on June 10, 2011.  The International Agency for Research on Cancer (IARC) has determined that styrene is a possible carcinogen.

### 1.6 HOW CAN STYRENE 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>	There are no studies evaluating the effects of styrene exposure on children or immature animals. It is likely that children would have the same health effects as adults. We do not know whether children would be more sensitive than adults to the effects of styrene.
<b>Birth defects</b>	Studies in workers have examined whether styrene can cause birth defects or low birth weight; however, the results are inconclusive. No birth defects were observed in animal studies.
<b>Breast milk</b>	Nursing infants can be exposed to styrene from breast milk.

### 1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO STYRENE?

<b>Tobacco smoke</b>	Styrene is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
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<b>Copier</b>	Styrene is released during the use of home copiers. Families should use a copier only when needed and turn it off when finished. It is also important to keep the room with the copier well ventilated.
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### 1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO STYRENE?

<b>Detecting exposure</b>	Styrene can be measured in blood, urine, and body tissues for a short time following exposure to moderate-to-high levels.
<b>Measuring exposure</b>	<p>The presence of styrene breakdown products (metabolites) in urine might indicate that you were exposed to styrene; however, these metabolites can also form when you are exposed to other substances.</p> <p>Measuring styrene metabolites in urine within 1 day of exposure allows medical personnel to estimate actual exposure level.</p> <p>The detection of these metabolites in your urine cannot be used to predict the kind of health effects that might develop from that exposure.</p>

### 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.

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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.

Some regulations and recommendations for styrene include the following:

<b>Drinking water</b>	The EPA has determined that exposure to styrene in drinking water at concentrations of 20 mg/L for 1 day or 2 mg/L for 10 days is not expected to cause any adverse effects in a child.  The EPA has determined that lifetime exposure to 0.1 mg/L styrene in drinking water is not expected to cause any adverse effects.
<b>Bottled water</b>	The FDA has determined that the styrene concentration in bottled drinking water should not exceed 0.1 mg/L.
<b>Workplace air</b>	OSHA set a legal limit of 100 ppm styrene in air averaged over an 8-hour work day.

### 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.

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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/>

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