



## Radiation Protection

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# Strontium

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Strontium (chemical symbol Sr) is a silvery metal that rapidly turns yellowish in air. Strontium is found naturally as a non-radioactive element. Strontium has 16 known isotopes. Naturally occurring strontium is found as four stable isotopes Sr-84, -86, -87, and -88. Twelve other isotopes are radioactive. Strontium-90 is the most important radioactive isotope in the environment, although strontium-89 can be found around reactors, and strontium-85 is used in industry and medicine.

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### Reference Information

People and Discoveries  
Commonly Encountered  
Radionuclides

Americium-241  
Cesium-137  
Cobalt-60  
Iodine-129 & -131  
Plutonium  
Radium  
Radon  
Strontium-90  
Technetium-99  
Tritium  
Thorium  
Uranium

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## The Basics

### Who discovered strontium?

In 1790 Adair Crawford and William Cruikshank first detected non-radioactive strontium in the mineral strontianite in Scotland. Metallic strontium was isolated in 1808 by Sir Humphry Davy.

Radioactive Sr-90, like many other radionuclides, was discovered in the 1940s in nuclear experiments connected to the development of the atomic bomb.

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### Where does strontium-90 come from?

Strontium-90 is a by-product of the fission of uranium and plutonium in nuclear reactors, and in nuclear weapons. Strontium-90 is found in waste from nuclear reactors. It can also contaminate reactor parts and fluids. Large amounts of Sr-90 were produced during atmospheric nuclear weapons tests conducted in the 1950s and 1960s and dispersed worldwide.

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### What are the properties of strontium-90?

Non-radioactive strontium and its radioactive isotopes have the same physical properties. Strontium is a soft metal similar to lead. Strontium is chemically very reactive, and is only found in compounds in nature.

When freshly cut, it has a silvery luster, but rapidly reacts with air and turns yellow. Finely cut strontium will burst into flame in air. Because of these qualities, it is generally stored in kerosene.

Strontium-90 emits a beta particle with, no gamma radiation, as it decays to yttrium-90 (also a beta-emitter). Strontium-90 has a half-life of 29.1 years. It behaves chemically much like calcium, and therefore tends to concentrate in the bones and teeth.

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### What is strontium-90 used for?

Strontium-90 is used as a radioactive tracer in medical and agricultural studies. The heat generated by strontium-90's radioactive decay can be converted to electricity for long-lived, portable power supplies. These are often used in remote locations, such as in navigational beacons, weather stations, and space vehicles.

Strontium-90 is also used in electron tubes, as a radiation source in industrial thickness gauges, and for the treatment of eye diseases. Controlled amounts of strontium-90 have been used as a treatment for bone cancer.

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## Exposure to Strontium-90

### How does strontium-90 get into the environment?

Strontium-90 was widely dispersed in the 1950s and 1960s in fall out from atmospheric testing of nuclear weapons. It has been slowly decaying since then so that current levels from these tests are very low.

Strontium-90 is also found in waste from nuclear reactors. It is considered one of the more hazardous constituents of nuclear wastes. The accident at the Chernobyl nuclear power plant also introduced a large amount of Sr-90 into the environment. A large part of the Sr-90 was deposited in the Soviet Republics. The rest was dispersed as fallout over Northern Europe and worldwide. No significant amount of strontium-90 reached the U.S.

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### How does strontium-90 change in the environment?

As strontium-90 decays, it releases radiation and forms yttrium-90 (Y-90), which in turn decays to stable zirconium. The half-life of Sr-90 is 29.1 years, and that of Yttrium-90 is 64 hours. Sr-90 emits moderate energy beta particles, and Y-90 emits very strong (energetic) beta particles. Strontium-90 can form many chemical compounds, including halides, oxides, and sulfides, and moves easily through the environment.

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### How do people come in contact with strontium-90?

Everyone is exposed to small amounts of strontium-90, since it is widely dispersed in the environment and the food chain. Dietary intake of Sr-90, however, has steadily fallen over the last 30 years with the suspension of nuclear weapons testing. People who live near or work in nuclear facilities may have increased exposure to Sr-90. The greatest concern would be the exposures from an accident at a nuclear reactor, or an accident involving high-level wastes.

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### How does strontium-90 get into the body?

People may inhale trace amounts of strontium-90 as a contaminant in dust. But, swallowing Sr-90 with food or water is the primary pathway of intake.

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### What does strontium-90 do once it gets into the body?

When people ingest Sr-90, about 70-80% of it passes through the body. Virtually all of the remaining 20-30% that is absorbed is deposited in the bone. About 1% is distributed among the blood volume, extracellular fluid, soft tissue, and surface of the bone, where it may stay and decay or be excreted.

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## Health Effects of Strontium-90

### How can strontium-90 affect people's health?

Strontium-90 is chemically similar to calcium, and tends to deposit in bone and blood-forming tissue (bone marrow). Thus, strontium-90 is referred to as a "bone seeker." Internal exposure to Sr-90 is linked to bone cancer, cancer of the soft tissue near the bone, and leukemia.

Risk of cancer increases with increased exposure to Sr-90. The risk depends on the concentration of Sr-90 in the environment, and on the exposure conditions.

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### Is there a medical test to determine exposure to strontium-90?

The most common test for exposure to strontium-90 is a bioassay, usually by urinalysis. As with most cases of internal contamination, the sooner the test is taken after ingesting or inhaling the contaminant, the more accurate the results will be. Most major medical centers should be capable of performing this test.

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## Protecting People from Strontium-90

### How do I know strontium if I'm near strontium-90?

Although you are exposed to tiny amounts of strontium-90 from past accidents and weapons testing, you cannot sense its presence. You need specialized equipment to detect Sr-90.

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### What can I do to protect myself and my family from strontium-90?

Strontium-90 dispersed in the environment, like that from atmospheric weapons testing, is almost impossible to avoid. You may also be exposed to tiny amounts from nuclear power reactors and certain government facilities. The more serious risk to you (though it is unlikely), is that you may unwittingly encounter an industrial instrument containing a Sr-90 radiation source. This is more likely if you work in specific industries:

- scrap metal sorting, sales and brokerage
- metal melting and casting
- municipal landfill operations.

#### [Radioactive Source Reduction and Management](#)

This site describes EPA's activities to reduce the use of radioactive sources in industry, track existing sources and recover orphan sources.

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### What is EPA doing about strontium-90?

EPA protects people and the environment from Sr-90 by establishing standards for the clean-up of contaminated sites, by setting limits on the amount of Sr-90 (and other radionuclides) that may be released to the air, and by setting limits on the amount of strontium-90 (and other radionuclides) that may be present in public drinking water.

EPA uses its authority under the Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as "Superfund") to set standards for the clean-up of existing contaminated sites. Cleanups must meet all environmental requirements that are relevant or applicable, including state regulations and regulations issued in connection with other federal environmental laws.

When these types of regulations are unavailable, or not protective enough, EPA sets site-specific cleanup levels. Site-specific standards limit the chance of developing cancer because of exposure to a site-related carcinogen (such as strontium-90) to between one in 10,000 and one in 1,000,000.

#### Superfund: EPA Radiation Guidances and Reports

This site provides information on radionuclides at Superfund sites.  
EPA's Superfund Hotline: 1-800-424-9346 or 1-800-535-0202

EPA uses its Clean Air Act authority to set limits on the amount of radionuclides, such as Sr-90, that may be released to the air.

#### RadNESHAPS

This site provides information on EPA's National Emission Standards for Hazardous Air Pollutants: Radionuclides.

EPA uses its Safe Drinking Water Act authority to establish maximum contaminant levels (MCLs) for beta emitters, such as strontium-90, in public drinking water. The MCL for beta emitters is 4 millirem per year or 8 picoCuries per liter of water.

#### Understanding Radiation in Your Life, Your World

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