

RUBIDIUM

(Data in metric tons of rubidium oxide unless otherwise noted)

Domestic Production and Use: Rubidium is not actively mined in the United States; however, occurrences are known in Alaska, Arizona, Idaho, Maine, South Dakota, and Utah. Rubidium is also associated with some evaporate mineral occurrences in other States. Rubidium is not a major constituent of any mineral; it is produced in small quantities as a byproduct of cesium, lithium, and strontium mining. Rubidium concentrate is produced as a byproduct of pollucite (cesium) and lepidolite (lithium) mining and is imported from other countries for processing in the United States. The United States sources the majority of pollucite from the largest known North American deposit at Bernic Lake, Manitoba, Canada.

Applications for rubidium and its compounds include biomedical research, electronics, specialty glass, and pyrotechnics. Specialty glasses are the leading market for rubidium; rubidium carbonate is used to reduce electrical conductivity, which improves stability and durability in fiber optic telecommunications networks. Biomedical applications include rubidium salts used in antishock agents, and the treatment of epilepsy and thyroid disorder; rubidium-82, a radioactive isotope, used as a blood-flow tracer in positron emission tomographic imaging; and rubidium chloride, used as an antidepressant. Rubidium atoms are used in academic research, including the development of quantum mechanics-based computing devices, a future application with potential for relatively high consumption of rubidium. Quantum computing research uses ultracold rubidium atoms in a variety of applications. Quantum computers, which have the ability to perform more complex computational tasks than traditional computers by calculating in two quantum states simultaneously, were expected to be in prototype phase within a decade.

Rubidium's photo-emissive properties make it ideal for electrical-signal generators in motion-sensor devices, night-vision devices, photoelectric cells (solar panels), and photomultiplier tubes. Rubidium is used as an atomic resonance-frequency-reference oscillator for telecommunications network synchronization, playing a vital role in global positioning systems. Rubidium-rich feldspars are used in ceramic applications for spark plugs and electrical insulators because of their high dielectric constant. Rubidium hydroxide is used in fireworks to oxidize mixtures and produce violet hues. The U.S. military frequency standard, the United States Naval Observatory (USNO) Time Scale, is based on 48 weighted atomic clocks, including 4 USNO rubidium fountain clocks.

Salient Statistics—United States: U.S. salient statistics, such as consumption, exports, and imports, are not available. Some concentrate, which was sourced primarily from Canada, was exported to the United States for further processing. Industry information during the last decade suggests an annual domestic consumption rate of approximately 2,000 kilograms.

In 2015, one company offered 1-gram ampoules of 99.75%-grade rubidium (metal basis) for \$80.30 and 100 grams ampoules of the same material for \$1,472.00, the same as in 2014 and a 4% increase from that of 2013. The price for 10-gram ampoules of 99.8% rubidium formate hydrate (metal basis) was \$56.20, the same as in 2014, and a 4% increase from that of 2013. The prices for 10 grams of 99.8% (metals basis) rubidium acetate, rubidium bromide, rubidium carbonate, rubidium chloride, and rubidium nitrate were \$47.00, \$62.00, \$59.30, \$55.10, and \$45.90, respectively. The price for a rubidium-plasma standard solution (10,000 µg/ml) was \$56.50 for 50 ml and \$84.20 for 100 ml.

Recycling: None.

Import Sources (2011–14): The United States is 100% import reliant on byproduct rubidium-concentrate imports, most of which were thought to be imported from Canada.

Tariff:	Item	Number	Normal Trade Relations
			<u>12–31–15</u>
	Alkali metals, other	2805.19.9000	5.5% ad val.
	Chlorides, other	2827.39.9000	3.7% ad val.
	Bromides, other	2827.59.5100	3.6% ad val.
	Nitrates, other	2834.29.5100	3.5% ad val.
	Carbonates, other	2836.99.5000	3.7% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: Domestic rubidium occurrences will remain uneconomic unless market conditions change, such as the discovery of new end uses or increased consumption for existing end uses, which in turn would lead to increased prices. No known human health issues are associated with naturally occurring rubidium, and its use has minimal environmental impact.

An underground mining operation at Bernic Lake, Manitoba, Canada, experienced a partial collapse in early 2013, in the area of the mine's crowning pillar, following a similar event in 2010. In 2015, work continued to stabilize the area during mine production. The mining rate was not expected to exceed 1,000 tons per day of pollucite. Operations in Argentina and Canada continued site sampling and development with the goal of establishing mines.

The National Institute of Standards and Technology created the world's first "photonic molecules," structures made of light, by firing two photons into a cloud of supercooled rubidium atoms. The development of this technology has potential applications in communications, fiber optics, and micrography. An extreme ultralow noise rubidium clock, or synchronized rubidium oscillator, was developed for potential defense applications, including airborne and radio communications, and radar.

World Mine Production and Reserves: One mine in Canada produced rubidium ore as a byproduct, which was processed as concentrate; however, production data for that mine are not available. Lepidolite and pollucite, the principal rubidium-containing minerals in global rubidium reserves, can contain up to 3.5% and 1.5% rubidium oxide, respectively. Rubidium-bearing mineral reserves are found in zoned pegmatites, which are exceptionally coarse-grained plutonic rocks that formed late in the crystallization of a silicic magma. Mineral resources exist globally, but extraction and concentration are cost prohibitive. Production is known to take place periodically in Canada, Namibia, and Zimbabwe, but production data are not available. Rubidium is also mined in China, but information regarding reserves and production is unavailable.

	Reserves¹
Canada	12,000
Namibia	50,000
Zimbabwe	10,000
Other countries	<u>8,000</u>
World total	80,000

World Resources: In addition to several significant rubidium-bearing zoned pegmatites in Canada, similar pegmatite occurrences have been identified in Afghanistan, China, Denmark, Germany, Japan, Kazakhstan, Namibia, Peru, Russia, the United Kingdom, the United States, and Zambia. Minor amounts of rubidium are reported in brines in northern Chile and China and in evaporites in France, Germany, and the United States (New Mexico and Utah).

Substitutes: Rubidium and cesium can be used interchangeably in many applications because they have similar physical properties and atomic radii. Cesium, however, is more electropositive than rubidium, making it a preferred material for some applications.

¹See [Appendix C](#) for resource/reserve definitions and information concerning data sources.