

CESIUM

(Data in kilograms of cesium content unless otherwise noted)

Domestic Production and Use: Pollucite, the ore mineral of cesium, may be found in zoned pegmatites worldwide. There are occurrences of cesium-bearing pollucite in pegmatites in Maine and South Dakota; however, these occurrences are not mined. Canada is the leading producer and supplier of pollucite concentrate, which is imported for processing by one corporation in the United States. The most widespread use of cesium is in cesium formate brines, a specialty, high-density drilling fluid used for completing high-temperature, high-pressure oil and gas wells in Argentina and in the North Sea. Cesium formate is especially useful for this application because of its density; it has a specific gravity of 2.3, which is more than twice the specific gravity of water.

Vibrations of cesium are used to maintain the accuracy of the atomic clocks at the U.S. Naval Observatory, Washington, DC. The master clock there provides a reference time, available to the public at (202) 762-1401. Atomic clocks that use cesium are accurate to a few hundred trillionths of a second and help synchronize the positions of the jets that track returning U.S. space shuttles. Global positioning satellites, Internet and cell phone transmissions, and missile guidance systems are all dependent on the accuracy of cesium atomic clocks.

Other applications of cesium include DNA separation techniques, infrared detectors, night vision devices, photoelectric cells, and traffic controls. Cesium-131 and cesium-137 are nuclear reactor-produced isotopes of cesium. These may be used, respectively, to treat prostate cancer or as brachytherapy where the radioactive source is placed within the cancerous area. Cesium chloride is also used in pill form to increase the pH level of tumor cells back to a normal level, which can slow the cancer's growth. This is usually used as an alternative cancer treatment for patients. Cesium-137 in the form of radioactive cesium chloride in stainless steel capsules is used in self-contained irradiators at hospitals and universities for blood irradiation and in biomedical and radiation research, as well as other industrial uses. Cesium-137 is also widely used in industrial gauges, in mining and geophysical instruments, and for sterilization of food, sewage, and surgical equipment.

Salient Statistics—United States: Production, consumption, import, and export data for cesium have not been available since the late 1980s. U.S. consumption and world mine production are unavailable. There is no trading of cesium, and therefore no market price is available. Consumption of cesium in the United States is small and is estimated to amount to only a few thousand kilograms per year. In 2008, one company offered 1-gram ampoules of 99.8% (metals basis) cesium for \$44.40 each and 99.98% (metals basis) cesium for \$58.40. The price for 50 grams of 99.8% (metals basis) cesium was \$583.00, and 100 grams of 99.98% (metals basis) cesium was priced at \$1,603.00. This is a 4.5% increase for the 99.8% (metals basis) cesium and a 5% increase for the 99.98% (metals basis) cesium from that of 2007.

Recycling: Cesium formate fluids are rented to oil and gas clients, and after completion of the well, the used cesium formate fluids are returned and reprocessed for subsequent drilling operations. Approximately 15% of the cesium formate may be lost in the well. There are no data available on the amounts used or recovered.

Import Sources (2004-07): Canada is the chief source of pollucite concentrate imported by the United States, and the United States is 100% import reliant.

Tariff: Item	Number	Normal Trade Relations
		<u>12-31-08</u>
Alkali metals, other	2805.19.9000	5.5% ad val.
Chlorides, other	2827.39.5000	3.7% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: Domestic cesium occurrences will remain uneconomic unless there is a change in the market, such as new or increased end uses. The United States is reliant on imports of pollucite concentrate from Canada for its cesium supply. Cost and reactivity of the metal point to continued limited applications. Commercially useful quantities of inexpensive cesium are available as a byproduct of the production of lithium metal. There are no known human health issues associated with cesium, and its use has minimal environmental impact.

Cesium formate brine usage is increasing in the oil and gas exploration industry. Cesium formate brine does not contain solids or oil, which dramatically improves well control, well integrity, as well as increases the speed of drilling. Aside from its use in drilling fluid, cesium formate brine also has an application as a fast-acting liquid pill for releasing drill pipes differentially stuck in oil-based mud (OBM) filter cakes. The pill of formate brine rapidly destroys the OBM filter cake and allows the pipe to be jarred free. Cesium-137 is being used to monitor oil flow in pipelines. Cesium-137 is added to a new batch of oil to let the receiving station know if there is new oil being sent. The radiation that is given off by cesium-137 can be easily detected by holding a detector at the end of the pipeline.

The International Atomic Energy Agency has indicated that cesium-137 is one of several radioactive materials that may be used in radiological dispersion devices or “dirty bombs.” As of February 2008, the National Research Council (NRC) has mandated that the U.S. government take steps to promote the replacement of cesium-137, with lower risk alternatives. The NRC suggested that alternatives could lower the potential for theft and misuse. For most applications, radioactive cesium chloride can be replaced by lower-hazard alternatives that will not change the performance of the equipment. Such options include using less hazardous forms of radioactive cesium, radioactive cobalt, and x-ray generators.

World Mine Production, Reserves, and Reserve Base: Pollucite is a hydrated aluminosilicate mineral that may form in association with lithium-rich, lepidolite-bearing or petalite-bearing zoned pegmatites, which are a type of granite with exceptionally large crystals. Cesium reserves and reserve base are therefore estimated based on the occurrence of pollucite, which is mined as a byproduct with the lithium mineral lepidolite. Concentrates of pollucite may contain about 20% cesium by weight; however, cesium resource and mine production data are either limited or not available. The deposit at Lac du Bonnet, Manitoba, Canada, contains approximately 300,000 tons of pollucite that grades 24% Cs₂O and also contains tantalum. The next largest occurrence that may be potentially economic is in Zimbabwe.

	Reserves¹	Reserve base¹
Canada	70,000,000	73,000,000
Namibia	—	9,000,000
Zimbabwe	—	23,000,000
Other countries	<u>NA</u>	<u>NA</u>
World total (rounded)	<u>70,000,000</u>	<u>110,000,000</u>

World Resources: World resources of cesium have not been estimated. Cesium may be associated with lithium-bearing pegmatites worldwide, and cesium resources have been identified in Namibia and Zimbabwe. Cesium occurrences are also known in brines in Chile and China and in geothermal systems in Germany, India, and Tibet.

Substitutes: Because of similar physical properties, proximity on the periodic table, and similar atomic radii, cesium and rubidium may be used interchangeably in many applications.

NA Not available. — Zero.

¹See Appendix C for definitions.