THALLIUM

(Data in kilograms of thallium content unless otherwise noted)

Domestic Production and Use: Thallium is a byproduct metal recovered in some countries from flue dusts and residues collected in the smelting of copper, zinc, and lead ores. Although thallium was contained in ores mined or processed in the United States, it has not been recovered domestically since 1981. Consumption of thallium metal and thallium compounds continued for most of its established end uses. These included the use of radioactive thallium isotope 201 for medical purposes in cardiovascular imaging; thallium as an activator (sodium iodide crystal doped with thallium) in gamma radiation detection equipment (scintillometer); thallium-barium-calcium-copper oxide high-temperature superconductor (HTS) used in filters for wireless communications; thallium in lenses, prisms and windows for infrared detection and transmission equipment; thallium-arsenic-selenium crystal filters for light diffraction in acousto-optical measuring devices; and thallium as an alloying component with mercury for low-temperature measurements. Other uses included an additive in glass to increase its refractive index and density, a catalyst for organic compound synthesis, and a component in high-density liquids for sink-float separation of minerals.

Salient Statistics—United States:	**2003**	**2004**	**2005**	**2006**	**2007[e]**
Production, mine	(1)	(1)	(1)	(1)	(1)
Imports for consumption (gross weight)					
Unwrought powders	36	117	23	—	—
Formed and articles	45	98	212	530	1,100
Waste and scrap	—	110	—	—	—
Total	81	325	235	530	1,100
Exports (gross weight)					
Unwrought powders	490	224	209	—	230
Formed and articles	668	965	43	1,090	40
Waste and scrap	39	—	—	—	1,800
Total	1,200	1,190	252	1,090	2,070
Consumption[e]	NA	900	300	NA	NA
Price, metal, dollars per kilogram[2]	1,300	1,600	1,900	4,650	4,560
Net import reliance[e, 3] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2003-06): Russia, 52%; Netherlands, 25%; and Belgium, 23%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-07**
Unwrought and powders	8112.51.0000	4.0% ad val.
Waste and scrap	8112.52.0000	Free.
Other	8112.59.0000	4.0% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The price for thallium metal remained high in 2007 as the supply worldwide continued to be relatively tight. The average price for high-purity granules and rod was nearly three times higher than the average price during the previous 3 years. China continued its policy of eliminating toll trading tax benefits on exports of thallium that began in 2006, thus contributing to the shortage on the world market. Higher internal demand for many metals, including thallium, has prompted China to begin importing greater quantities of thallium. Some of this import increase was in the form of thallium waste and scrap from the United States.

Research and development activities of both a basic and applied nature were conducted during 2007 that could expand the use of thallium. Activities included the development of HTS materials for such applications as magnetic resonance imaging, storage of magnetic energy, magnetic propulsion, more efficient electrical motors, and electric power generation and transmission. Experimental results showed that the superconductivity properties exhibited in a lead-tellurium (PbTe) semiconductor doped with thallium resulted from a simple exchange of paired electrons between two thallium valence states and the PbTe valence band. Doping with cations other than thallium in the concentration range of study did not yield superconductivity properties in the PbTe semiconductor. In other research, thallium sulfide thin films of several different compositions were formed on both glass and polyethylene plastic. The photoconductive properties of these thin films may find use in solar batteries and other devices.

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THALLIUM

A broad range of commercial applications would become available if HTS materials could be fabricated on a large scale into wires having a certain degree of flexibility and strength. Currently, HTS materials are relatively brittle metal-oxide ceramics. There are now more than 50 known HTS materials, but only a few (nonthallium) have been used successfully to form long-length wires.

In medical applications, dipyridamole-thallium imaging continued to be a useful preoperative procedure for assessing long-term cardiac risks in patients with coronary artery disease or diabetes who are undergoing peripheral vascular surgery. Further uses of radioactive thallium in clinical diagnostic applications include cardiovascular and oncological imaging.

Thallium metal and its compounds are highly toxic materials and are strictly controlled to prevent a threat to humans and the environment. Thallium and its compounds can be absorbed into the human body by skin contact, ingestion, or inhalation of dust or fumes. Further information on thallium toxicity can be found in the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System database. Under its national primary drinking water regulations, the EPA has set an enforceable Maximum Contaminant Level for thallium at 2 parts per billion. All public water supplies must abide by these regulations. The EPA continues to conduct studies at its National Risk Management Research Laboratory (NRMRL) to develop and promote technologies that protect and improve human health and the environment. Studies were conducted recently at NRMRL on methods to remove thallium from mine wastewaters.

World Mine Production, Reserves, and Reserve Base:[4]

	Mine production		Reserves[5]	Reserve base[5]
	2006	2007[e]		
United States	(1)	(1)	32,000	120,000
Other countries	10,000	10,000	350,000	530,000
World total (rounded)	10,000	10,000	380,000	650,000

World Resources: World resources of thallium contained in zinc resources total about 17 million kilograms; most are located in Canada, Europe, and the United States. An additional 630 million kilograms is in world coal resources. The average thallium content of the Earth's crust has been estimated to be 0.7 part per million.

Substitutes: The apparent leading potential demand for thallium could be in the area of HTS materials, but demand will be based on which HTS formulation has a combination of favorable electric and physical qualities and is best suited for fabrication. A firm presently using a thallium HTS material in filters for wireless communications is considering using a nonthallium HTS. While research in HTS continues, and thallium is part of that research effort, it is not guaranteed that HTS products will be a large user of thallium in the future.

Although other materials and formulations can substitute for thallium in gamma radiation detection equipment and optics used for infrared detection and transmission, thallium materials are presently superior and more cost effective for these very specialized uses.

Nonpoisonous substitutes like tungsten compounds are being marketed as substitutes for thallium in high-density liquids for sink-float separation of minerals.

[e]Estimated. NA Not available. — Zero.

[1]No reported mine production; flue dust and residues from base-metal smelters, from which thallium metal and compounds may be recovered, are being exported to Canada, France, the United Kingdom, and other countries.

[2]Estimated price of 99.999%-pure granules or rods in 100- to 250-gram or larger lots.

[3]Defined as imports – exports + adjustments for Government and industry stock changes. Consumption and exports of unwrought thallium were from imported material or from a drawdown in unreported inventories.

[4]Estimates are based on thallium content of zinc ores.

[5]See Appendix C for definitions.