

## THORIUM

(Data in metric tons of thorium oxide (ThO<sub>2</sub>) equivalent, unless noted)

**Domestic Production and Use:** Monazite, a rare-earth and thorium phosphate mineral, was not mined domestically in 1995. In prior years, monazite had been recovered by dredging methods by one mine in Green Cove Springs, FL. Production had been as a byproduct during processing for titanium and zirconium minerals and monazite was recovered for its rare-earth content. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials purchased from U.S. Government stockpiles. About 14 companies processed or fabricated various forms of thorium for nonenergy uses, such as ceramics, carbon arc lamps, magnesium-thorium alloys, and welding electrodes. The value of thorium metal, alloys, and compounds used by the domestic industry was estimated to be about \$200,000.

<b>Salient Statistics—United States:</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995<sup>e</sup></b>
Production, refinery <sup>1</sup>	NA	—	—	—	—
Imports: Thorium ore and concentrates (monazite)					
gross weight	—	—	—	—	40
Compounds	43	14	18	3	10
Exports: Thorium ore and concentrates (monazite)					
gross weight	—	5	—	33	—
Compounds	3	<1	<1	<1	<1
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, reported <sup>e</sup>	54	40	13	17	NA
Price, yearend, dollars per kilogram:					
Nitrate, welding-grade <sup>2</sup>	NA	5.46	5.46	5.46	5.46
Nitrate, mantle-grade <sup>3</sup>	19.94	21.36	22.25	23.30	23.30
Oxide, yearend: 99.0% purity <sup>4</sup>	63.80	63.80	65.00	63.80	NA
99.9% purity <sup>4</sup>	NA	NA	NA	NA	88.50
99.99% purity	—	107.00	107.00	107.25	107.25
Stocks, industrial, yearend	NA	NA	NA	NA	NA
Employment, mine	—	—	—	—	—
Net import reliance <sup>5</sup> as a percent of apparent consumption	NA	NA	NA	NA	NA

**Recycling:** None.

**Import Sources (1991-94):** Monazite: Australia, 100%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Most favored nation (MFN) 12/31/95</b>	<b>Non-MFN<sup>6</sup> 12/31/95</b>
	Thorium ores and concentrates (monazite)	2612.20.0000	Free	Free.
	Thorium compounds	2844.30.1000	7.3% ad val.	35% ad val.

**Depletion Allowance:** Percentage method: Monazite, 22% on thorium content, 14% on rare-earth and yttrium content (Domestic); 14% (Foreign).

### **Government Stockpile:**

#### Stockpile Status—9-30-95

<b>Material</b>	<b>Uncommitted inventory</b>	<b>Committed inventory</b>	<b>Authorized for disposal</b>	<b>Disposals Jan.-Sept. 95</b>
Thorium nitrate	3,219	—	2,969	—
(thorium oxide equivalent)	(1,540)	—	(1,420)	—

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**Events, Trends, and Issues:** Domestic mine production of thorium-bearing minerals ceased in 1995 when the sole producer discontinued recovered. With mine production terminated, the United States is now 100% import dependent for additional supplies. Overall demand for thorium products has continued to decline.

A decision by the one mine producer in Florida to cease production of monazite in 1995 was the result of decreased worldwide demand for radioactive thorium-bearing ores. As a result of several domestic processors switching to thorium-free concentrates, the buildup of any thorium residues has switched from the domestic processor to the foreign ore refiner. Domestic consumption is forecast to continue to decline with annual demand in nonenergy uses expected to remain below 20 tons of equivalent thorium oxide. The use of thorium in United States has decreased significantly since 1990. Costs to monitor and dispose of thorium continued to increase and have resulted in most domestic processors switching to thorium-free materials.

Real and potential costs related to compliance with State and Federal regulations, proper disposal, and monitoring of thorium's radioactivity have limited thorium's commercial value. It is forecast that thorium's use will continue to decline unless a low-cost disposal process is developed.

### **World Refinery Production, Reserves, and Reserve Base:**

	Refinery production		Reserves <sup>7</sup>	Reserve base <sup>7</sup>
	1994	1995		
United States	—	—	158,000	298,000
Australia	NA	NA	300,000	340,000
Brazil	NA	NA	16,000	18,000
Canada	NA	NA	100,000	100,000
India	NA	NA	292,000	300,000
Malaysia	NA	NA	4,500	4,500
Norway	NA	NA	166,000	183,000
South Africa	NA	NA	35,000	39,000
Other countries	NA	NA	90,000	100,000
World total (rounded)	NA	NA	1,200,000	1,400,000

Reserves and reserve base are contained primarily in the rare-earth ore mineral, monazite. Without demand for the rare earths, monazite would probably not be recovered for its thorium content. Other ore minerals with higher thorium contents, such as thorite, would be more likely sources if demand significantly increased. No new demand, however, is expected. Reserves exist primarily in recent and ancient placer deposits. Lesser quantities of thorium-bearing monazite reserves occur in vein deposits and carbonatites.

**World Resources:** Thorium resources occur in provinces similar to those of reserves. The largest share are contained in placer deposits. Resources of more than 500,000 tons are contained in placer, vein, and carbonatite deposits. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons. Large thorium resources are found in Australia, Brazil, Canada, Greenland, India, South Africa, and the United States.

**Substitutes:** Nonradioactive substitutes have been developed for many applications for thorium. Yttrium compounds have replaced thorium compounds in incandescent lamp mantles. Although the yttrium substitute is slightly lower in brightness, it is less brittle and nonradioactive. A magnesium alloy containing lanthanides, zirconium, and yttrium can substitute for magnesium-thorium alloys in aerospace applications. Research to develop nonradioactive substitutes continues in the industry.

<sup>6</sup>Estimated. NA Not available.

<sup>1</sup>All domestically consumed thorium was derived from imported materials.

<sup>2</sup>Source: U.S. Department of Defense, Defense Logistics Agency. Based on sales from the National Defense Stockpile.

<sup>3</sup>Source: Rhône-Poulenc Basic Chemical Co., f.o.b. port of entry, duty paid, ThO<sub>2</sub> basis, 1990-91. Rhône-Poulenc Canada Inc., f.o.b. Ontario, Canada, duty unpaid, 1992-93. Rhône-Poulenc Basic Chemicals Co., Shelton, CT, 1994.

<sup>4</sup>Source: Rhône-Poulenc Basic Chemicals Co., f.o.b. port of entry, duty paid.

<sup>5</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>6</sup>See Appendix B.

<sup>7</sup>See Appendix C for definitions.