

THORIUM

(Data in metric tons of thorium oxide (ThO₂) equivalent, unless otherwise noted)

Domestic Production and Use: Monazite, a rare-earth and thorium phosphate mineral, is the primary source of the world's thorium. It was not mined domestically in 1996. In prior years, monazite had been recovered by dredging methods by a company at 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 shipped from U.S. Government stockpiles. About eight 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 \$1 million.

Salient Statistics—United States:	1992	1993	1994	1995	1996^e
Production, refinery ¹	—	—	—	—	—
Imports: Thorium ore and concentrates (monazite), gross weight	—	—	—	40	12
Compounds	14	18	3	20	29
Exports: Thorium ore and concentrates (monazite), gross weight	5	—	33	—	(²)
Compounds	(²)	(²)	(²)	(²)	(²)
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, reported ^e	40	13	17.3	18.1	NA
Price, yearend, dollars per kilogram:					
Nitrate, welding-grade ³	5.46	5.46	5.46	5.46	5.46
Nitrate, mantle-grade ⁴	21.36	22.25	23.30	23.30	23.30
Oxide, yearend: 99.0% purity ⁵	63.80	65.00	63.80	NA	NA
99.9% purity ⁵	NA	NA	NA	88.50	90.00
99.99% purity	107.00	107.00	107.25	107.25	107.25
Stocks, industrial, yearend	NA	NA	NA	NA	NA
Employment, mine	—	—	—	—	—
Net import reliance ⁶ as a percent of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (1992-95): Monazite: Australia, 89%; and Malaysia, 11%. Thorium compounds: France, 99%; and Canada, Switzerland, and United Kingdom, 1%.

Tariff:	Item	Number	Most favored nation (MFN) 12/31/96	Non-MFN⁷ 12/31/96
	Thorium ores and concentrates (monazite)	2612.20.0000	Free	Free.
	Thorium compounds	2844.30.1000	6.9% 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—9-30-96

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposals Jan.-Sept. 96
Thorium nitrate	3,219	—	2,969	—
(thorium oxide equivalent in thorium nitrate)	1,539	—	1,420	—

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Events, Trends, and Issues: Domestic mine production of thorium-bearing monazite ceased at the end of 1994 as world demand for thorium-bearing ores remained depressed. Imports supplied essentially all of the thorium consumed in the United States in 1996. Imports of thorium compounds increased from the previous year to meet demand in catalysis. Overall, domestic consumption remained small at 18.1 tons, a slight increase from the previous year.

Based on import data through July 1996, the unit value of imports of thorium ore and concentrates (monazite), was \$406 per metric ton gross weight. The average value of thorium compounds, imported during the same time period, was \$58 per kilogram.

Worldwide demand for thorium-bearing rare-earth ores remained low. A French firm continued to seek approval to build a monazite separation plant in Pinjarra, Western Australia, Australia. The disposal of thorium is the primary concern in obtaining permitting for the Australian plant. The company reinitiated development of the Pinjarra project as a result of the French Government's decision in 1994 to disallow any further disposal of thorium residues within the country.

The use of thorium in the United States has decreased significantly since 1990. Increased costs to monitor and dispose of thorium have caused the domestic processors to switch 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 ⁸	Reserve base ⁸
	<u>1995</u>	<u>1996</u>		
United States	—	—	160,000	300,000
Australia	—	—	300,000	340,000
Brazil	NA	NA	16,000	18,000
Canada	NA	NA	100,000	100,000
India	NA	NA	290,000	300,000
Malaysia	—	—	4,500	4,500
Norway	—	—	170,000	180,000
South Africa	NA	NA	35,000	39,000
Other countries	<u>NA</u>	<u>NA</u>	<u>90,000</u>	<u>100,000</u>
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. A magnesium alloy containing lanthanides, zirconium, and yttrium can substitute for magnesium-thorium alloys in aerospace applications.

⁸Estimated. NA Not available.

¹All domestically consumed thorium was derived from imported materials.

²Less than ½ unit.

³Source: U.S. Department of Defense, Defense Logistics Agency. Based on sales from the National Defense Stockpile.

⁴Source: Rhône-Poulenc Basic Chemicals Co., f.o.b. port of entry, duty paid, ThO₂ basis, f.o.b. Ontario, Canada, duty unpaid, 1992-93. Rhône-Poulenc Basic Chemicals Co., Shelton, CT, 1994-96.

⁵Source: Rhône-Poulenc Basic Chemicals Co., f.o.b. port of entry, duty paid.

⁶Defined as imports - exports + adjustments for Government and industry stock changes.

⁷See Appendix B.

⁸See Appendix C for definitions.