YTTRIUM1

(Data in metric tons of yttrium oxide (Y₂O₃) content, unless otherwise noted)

<u>Domestic Production and Use</u>: The rare-earth element, yttrium, was mined by one company as a constituent of the mineral bastnasite, but was not recovered as a separate element during processing. Bastnasite, a rare-earth fluocarbonate mineral, was mined as a primary product by one company at Mountain Pass, CA. Bastnasite's yttrium content is very small, and represents a potential minor source of the element. Yttrium used by the domestic industry was imported primarily as compounds.

Yttrium was used in many applications. Principal uses were in phosphors used in color televisions and computer monitors, trichromatic fluorescent lights, temperature sensors, and X-ray intensifying screens. As a stabilizer in zirconia, yttrium was used in wear-resistant and corrosion-resistant cutting tools, seals and bearings, high-temperature refractories for continuous-casting nozzles, jet engine coatings, oxygen sensors in automobile engines, and simulant gemstones. In electronics, yttrium-iron-garnets were components in microwave radar to control high frequency signals. Yttrium was an important component in yttrium-aluminum garnet laser crystals used in industrial cutting and welding, medical and dental surgical procedures, temperature and distance sensing, photoluminescence, photochemistry, digital communications, and nonlinear optics. Yttrium was also used in heating-element alloys, superalloys, and high-temperature superconductors. The approximate distribution in 1996 by end use was as follows: lamp and cathode ray tube phosphors, 98%; oxygen sensors, laser crystals, and miscellaneous, 2%.

Salient Statistics—United States:	<u> 1993</u>	<u>1994</u>	<u> 1995</u>	<u> 1996</u>	<u> 1997°</u>
Production, mine	W	W		_	_
Imports for consumption:					
In monazite			0.4	1	
In xenotime and yttrium concentrate ²	NA	NA	NA	NA	NA
Exports, in ore and concentrate	NA	NA	NA	NA	NA
Consumption, estimated	NA	344	365	207	315
Price, dollars:4					
Monazite concentrate, per metric ton	204-238	233-272	222-259	244-285	224-262
Yttrium oxide, per kilogram, 99.0% to 99.99% purity	16-116	20-116	17-110	17-85	17-85
Yttrium metal, per kilogram, 99.0% to 99.9% purity	135-350	135-350	150-200	95-200	80-100
Stocks, processor, yearend	NA	NA	NA	NA	NA
Net import reliance as a percent of					
apparent consumption	100	100	100	100	100

Recycling: Small quantities, primarily from laser crystals and synthetic garnets.

Import Sources (1996): Yttrium compounds: China, 81%; and Japan, 19%.

Tariff: Item	Number	Most favored nation (MFN) 12/31/97	Non-MFN⁵ <u>12/31/97</u>	
Thorium ores and concentrates (monazite) Rare-earth metals, scandium and yttrium,	2612.20.0000	Free	Free.	
whether or not intermixed or interalloyed Yttrium bearing materials and compounds	2805.30.0000	5.0% ad val.	31.3% ad val.	
containing by weight >19% but <85% Y ₂ O ₃ Rare-earth compounds, including yttrium oxide, yttrium nitrate, and other individual	2846.90.4000	Free	25% ad val.	
compounds	2846.90.8000	3.7% ad val.	25% ad val.	

<u>Depletion Allowance</u>: Percentage method: Monazite: 22% on thorium content and 14% on yttrium and rare-earth content (Domestic), 14% (Foreign). Xenotime: 14% (Domestic and Foreign).

Government Stockpile: None.

YTTRIUM

Events, Trends, and Issues: Yttrium demand which decreased in 1996, rebounded in 1997 as prices were stable to slightly lower. Yttrium markets continued to be competitive, although China was the source of most of the world's supply. The U.S. economy showed strong growth in the first half of 1997, and demand for yttrium in most uses increased.

Yttrium was consumed primarily in the form of high-purity compounds, especially the oxide and nitrate.

World Mine Production, Reserves, and Reserve Base:

	Mine production ⁶		Reserves ⁷	Reserve base ⁷	
	<u>1996</u>	<u>1997°</u>			
United States	_	_	120,000	130,000	
Australia	_	_	100,000	110,000	
Brazil	5	5	400	1,500	
Canada	_	_	3,300	4,000	
China	1,400	1,300	220,000	240,000	
Congo (Kinshasa) ⁸	1	1	570	630	
India	55	55	36,000	38,000	
Malaysia	7	6	13,000	21,000	
South Africa	_	_	4,400	5,000	
Sri Lanka	2	2	240	260	
Thailand	_	_	600	600	
Former Soviet Union ⁹	120	120	9,000	10,000	
World total (rounded)	1,600	1,500	510,000	560,000	

<u>World Resources</u>: Large resources of yttrium in monazite and xenotime are available worldwide in ancient and recent placer deposits (monazite and xenotime), weathered clay deposits (ion-adsorption ore), carbonatites, and uranium ores. Additional large subeconomic resources of yttrium occur in other monazite-bearing deposits, apatite-magnetite rocks, sedimentary phosphate deposits, deposits of columbium-tantalum minerals, and certain uranium ores, especially those of the Blind River District in Canada. It is probable that the world's resources are very large relative to expected demand.

<u>Substitutes</u>: Substitutes for yttrium are available for some applications, but generally are much less effective. In most uses, especially in phosphors, electronics, and lasers, yttrium is not subject to substitution by other elements. As a stabilizer in zirconia ceramics, yttria may be substituted with calcia or magnesia.

^eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

¹See also Rare-Earths and Scandium.

²This import category typically includes yttrium concentrates.

³Essentially all yttrium consumed domestically was imported or refined from imported ores and concentrates.

⁴Monazite concentrate price derived from Metals Bulletin; yttrium oxide and metal prices from Elements (a TradeTech publication), and Rhône-Poulenc Basic Chemicals Co.

⁵See Appendix B.

⁶Includes yttrium contained in rare-earth ores.

⁷See Appendix D for definitions.

⁸Formerly Zaire.

⁹As constituted before Dec. 1991.