SCANDIUM

(Data in kilograms of scandium oxide content, unless otherwise noted)

Domestic Production and Use: Demand for scandium increased in 1996. Although scandium was not mined domestically in 1996, quantities sufficient to meet demand were available from domestic concentrates and tailings. Principal domestic sources of scandium were tailings previously generated by mining fluorite at Crystal Mountain, MT, and tailings previously produced from tantalum processing in Muskogee, OK. Companies that processed scandium ores, concentrates, and low-purity compounds to produce refined scandium products were in Mead, CO; Urbana, IL; and Newport, TN . Capacity to produce ingot and distilled scandium metal was located in Phoenix, AZ; Urbana, IL; and Ames, IA. Scandium used in the United States was derived from both domestic and foreign sources. Principal uses for scandium in 1996 were metallurgical research, high-intensity metal halide lamps, analytical standards, electronics, and laser research.

Salient Statistics—United States:	1992	1993	1994	1995	1996[e]
Production, refinery	W	W	W	W	W
Imports for consumption	NA	NA	NA	NA	NA
Exports	NA	NA	NA	NA	NA
Consumption	W	W	W	W	W
Price, yearend, dollars:					
Per kilogram, oxide, 99.0% purity	1,500	1,600	1,600	1,500	1,400
Per kilogram, oxide, 99.9% purity	3,000	3,300	3,300	3,300	2,900
Per kilogram, oxide, 99.99% purity	5,000	5,200	5,200	5,100	4,400
Per kilogram, oxide, 99.999% purity	10,000	9,000	9,000	7,650	6,750
Per gram, powder, metal[1]	372.00	372.00	372.00	372.00	372.00
Per gram, sublimed, metal[2]	312.00	312.00	169.00	169.00	169.00
Per gram, scandium bromide, 99.99% purity[3]	NA	80.00	80.00	80.00	80.00
Per gram, scandium chloride, 99.9% purity[3]	NA	62.00	37.00	37.00	37.00
Per gram, scandium fluoride, 99.9% purity[3]	NA	129.00	77.00	77.00	77.00
Per gram, scandium iodide, 99.999% purity[3]	NA	78.00	78.00	78.00	78.00
Stocks	NA	NA	NA	NA	NA
Employment, processors, number	12	12	12	8	5
Net import reliance[4] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: Minor, recovered from laser crystal rods.

Import Sources (1992-95): Not available.

Tariff: Item	Number	Most-favored-nation (MFN) 12/31/96	Non-MFN[5] 12/31/96
Mineral substances not elsewhere specified or included: Including scandium ores	2530.90.0000	Free	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or inter-alloyed including scandium	2805.30.0000	5.0% ad val.	31.3% ad val.
Mixtures of rare-earth oxides except cerium oxide, including scandium oxide mixtures	2846.90.2010	Free	25% ad val.
Rare-earth compounds, including individual rare-earth oxides,hydroxides, nitrates, and other individual compounds, including scandium oxide	2846.90.8000	3.7% ad val.	25% ad val.
Aluminum alloys, other: Including scandium-aluminum	7601.20.9090	Free	10.5% ad val.

Depletion Allowance: Percentage method, 14% (Domestic), 14% (Foreign).

Government Stockpile: None.

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SCANDIUM

Events, Trends, and Issues: Nominal prices for domestically produced scandium compounds were lower for the fourth consecutive year. The supply of domestic and foreign scandium remained strong despite increased demand. Although demand increased in 1996, the total market remained very small. Domestic increases in demand were almost exclusively the result of acquisitions for metallurgical research.

Scandium's use continued to increase in metal halide lighting. Scandium additions, as the metal or the iodide, mixed with other elements, were added to halide light bulbs to adjust the color to appear like natural sunlight. Demand also continued to increase for scandium-aluminum alloys. Future development is expected to occur in alloys for aerospace and specialty markets, including sports equipment. Market activity increased in 1996, primarily to meet demand for alloying. Scandium's availability from the former Soviet Union (former U.S.S.R.) increased substantially back in 1992, after export controls were relaxed, and sales to the Western World have been increasing. China also continued to supply a small quantity of goods to the U.S. market.

The price of scandium materials varies greatly based on purity and quantity. The weight-to-price ratio of scandium metals and compounds was generally much higher for gram quantities than for kilogram purchases. Kilogram prices for scandium metal ingot were typically double the cost of the starting scandium compound, while higher purity distilled or sublimed metal ranged from four to six times the cost of the starting material.

World Mine Production, Reserves, and Reserve Base: Scandium was produced as a byproduct material in China, Kazakstan, and Russia. Foreign mine production data were not available. No scandium was mined in the United States in 1996. Scandium occurs in many ores in trace amounts but has not been found in sufficient quantities to be considered a reserve or reserve base.[6] As a result of its low concentration, scandium has been produced exclusively as a byproduct during processing of various ores or recovered from previously processed tailings or residues.

World Resources: Resources of scandium are abundant, especially when considered in relation to actual and potential demand. Scandium is rarely concentrated in nature due to its lack of affinity to combine with the common ore forming anions. It is widely dispersed in the lithosphere and forms solid solutions in over a 100 minerals. In the Earth's crust, scandium is primarily a trace constituent of ferromagnesium minerals. Concentrations in these minerals (amphibole-hornblende, pyroxene, and biotite) typically range from 5 to 100 parts per million equivalent Sc_2O_3. Ferromagnesium minerals commonly occur in the igneous rocks, basalt, and gabbro. Enrichment of scandium also occurs in rare-earth minerals, wolframite, columbite, cassiterite, beryl, garnet, muscovite, and the aluminum phosphate minerals. Recent domestic production has primarily been from the scandium-yttrium silicate mineral, thortveitite, and from byproduct leach solutions from uranium operations. Future production is expected from tantalum residues. One of the principal domestic scandium resources is the fluorite tailings from the Crystal Mountain deposit near Darby, MT. Tailings from the mined-out fluorite operations, which were generated from 1952 to 1971, contain the scandium mineral, thortveitite, and other associated scandium-enriched minerals. Resources are also contained in the tantalum residues previously processed at Muskogee, OK. Smaller resources are contained in tungsten, molybdenum, and titanium minerals from the Climax molybdenum deposit in Colorado, and in kolbeckite (sterrettite), varisite, and crandallite at Fairfield, UT. Other lower grade domestic resources are present in ores of aluminum, iron, molybdenum, nickel, phosphate, tantalum, tin, titanium, tungsten, zinc, and zirconium. Process residues from tungsten operations in the United States also contain significant amounts of scandium.

Foreign resources are known in China, Kazakstan, Madagascar, Norway, and Russia. China's resources are in tin, tungsten, and iron deposits in Jiangxi, Guangxi, Guangdong, Fujian, and Zhejian Provinces. Resources in Russia and Kazakstan are in the Kola Peninsula apatites and in uranium-bearing deposits, respectively. Scandium in Madagascar is contained in pegmatites in the Befanomo area. Resources in Norway are dispersed in the thortveitite-rich pegmatites of the Iveland-Evje Region and a deposit in the northern area of Finnmark. An occurrence of the mineral thortveitite is reported for Kobe, Japan. Undiscovered scandium resources are thought to be very large.

Compared to the Earth, significantly higher scandium concentrations have been measured in extraterrestrial rocks. Crystalline rocks from the Earth's moon are higher in scandium by a factor of three.

Substitutes: In scandium's few applications, such as lighting and lasers, it is generally not subject to substitution.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Less than 250 micron, 99.9% purity, 1990 through 1995 prices converted from 0.5 gram price, from Alfa Aesar.

[2]Lump, sublimed dendritic 99.99% purity, from Alfa Aesar.

[3]Bromide, chloride, and fluoride in crystalline or crystalline aggregate form and scandium iodide as powder from Alfa Aesar.

[4]Defined as imports - exports + adjustments for Government and industry stock changes.

[5]See Appendix B.

[6]See Appendix C for definitions.