SCANDIUM

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

Domestic Production and Use: Demand for scandium increased in 2000. Although scandium was not mined domestically in 2000, quantities sufficient to meet demand were available in domestic tailings. Principal sources were imports from Russia and Ukraine. Companies that processed scandium ores, concentrates, and low-purity compounds to produce refined scandium products were in Mead, CO; Urbana, IL; and Knoxville, 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 essentially derived from foreign sources. Principal uses for scandium in 1999 were aluminum alloys for sporting equipment, metallurgical research, high-intensity metal halide lamps, analytical standards, electronics, and laser research.

Salient Statistics—United States:	1996	1997	1998	1999	2000[e]
Price, yearend, dollars:					
Per kilogram, oxide, 99.0% purity	1,400	1,400	1,100	900	700
Per kilogram, oxide, 99.9% purity	2,900	2,900	2,300	2,000	2,000
Per kilogram, oxide, 99.99% purity	4,400	4,400	3,400	3,000	3,000
Per kilogram, oxide, 99.999% purity	6,750	6,750	5,750	4,000	6,000
Per gram, powder, metal[1]	372.00	285.00	285.00	270.00	270.00
Per gram, sublimed, metal[2]	169.00	172.00	172.00	175.00	175.00
Per gram, scandium bromide, 99.99% purity[3]	80.00	90.00	90.00	91.80	91.80
Per gram, scandium chloride, 99.9% purity[3]	37.00	38.80	38.80	39.60	39.60
Per gram, scandium fluoride, 99.9% purity[3]	77.00	78.50	78.50	80.10	80.10
Per gram, scandium iodide, 99.999% purity[3]	78.00	148.00	148.00	151.00	151.00
Net import reliance[4] as a percent of apparent consumption	100	100	100	100	100

Recycling: Very minor, recovered from laser crystal rods.

Import Sources (1996-99): Not available.

Tariff: Item	Number	Normal Trade Relations 12/31/00
Mineral substances not elsewhere specified or included: Including scandium ores	2530.90.0000	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed including scandium	2805.30.0000	5.0% ad val.
Mixtures of rare-earth oxides except cerium oxide, including scandium oxide mixtures	2846.90.2010	Free.
Rare-earth compounds, including individual rare-earth oxides, hydroxides, nitrates, and other individual compounds, including scandium oxide	2846.90.8000	3.7% ad val.
Aluminum alloys, other: Including scandium-aluminum	7601.20.9090	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Nominal prices for domestically produced scandium compounds decreased from the previous year. The supply of domestic and foreign scandium remained strong despite increased demand. Although demand increased in 2000, the total market remained very small. Domestic increases in demand were primarily from recently developed applications in welding wire, scandium-aluminum baseball and softball bats, scandium-aluminum bicycle frames, and lacrosse sticks. A domestic gun manufacturer began producing high-strength, lightweight handgun frames and cylinders from scandium-aluminum alloys. Future demand is expected to be in fuel cells.

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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 has increased since 1998, primarily to meet demand for alloying. Scandium's availability from the former Soviet Union increased substantially in 1992, after export controls were relaxed, and sales to the Western World, especially from Ukraine, 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, Kazakhstan, Ukraine, and Russia. Foreign mine production data were not available. No scandium was mined in the United States in 2000. Scandium occurs in many ores in trace amounts, but has not been found in sufficient quantities to be considered a reserve or reserve base. 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 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, 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 Australia, China, Kazakhstan, Madagascar, Norway, Russia, and Ukraine. Resources in Australia are contained in a nickel and cobalt deposit in Syerston, New South Wales. China's resources are in tin, tungsten, and iron deposits in Jiangxi, Guangxi, Guangdong, Fujian, and Zhejian Provinces. Resources in Russia and Kazakhstan 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. In Ukraine, scandium is recovered as a byproduct of iron ore processing at Zheltye Voda. An occurrence of the mineral thortveitite is reported from Kobe, Japan. Undiscovered scandium resources are thought to be very large.

Substitutes: In applications, such as lighting and lasers, scandium is generally not subject to substitution. In metallurgical applications, titanium and aluminum high-strength alloys and carbon fiber may substitute in sporting goods, especially bicycle frames.

[e]Estimated.

[1]Less than 250 micron, 99.9% purity, 1995 through 1999 prices converted from 0.5-gram price, from Alfa Aesar, a Johnson Matthey company.

[2]Lump, sublimed dendritic 99.99% purity, from Alfa Aesar, a Johnson Matthey company.

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

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