SCANDIUM[1]

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

Domestic Production and Use: Demand for scandium decreased slightly in 2007. Although scandium was not mined domestically in 2007, quantities sufficient to meet demand were available in domestic tailings. Principal sources were imports from China, Russia, and Ukraine. Domestic companies with scandium-processing capabilities were located in Mead, CO, and Urbana, IL. 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 2007 were aluminum alloys for sporting equipment (baseball and softball bats, bicycle frames, crosse handles, golf clubs, gun frames, and tent poles), metallurgical research, high-intensity metal halide lamps, analytical standards, electronics, oil well tracers, and lasers.

Salient Statistics—United States:	**2003**	**2004**	**2005**	**2006**	**2007[e]**
Price, yearend, dollars:					
Per kilogram, oxide, 99.0% purity	500	500	500	700	700
Per kilogram, oxide, 99.9% purity	1,300	1,300	1,300	1,400	1,400
Per kilogram, oxide, 99.99% purity[2]	2,500	2,500	2,500	1,450	1,620
Per kilogram, oxide, 99.999% purity[2]	3,200	3,200	3,000	1,500	2,540
Per kilogram, oxide, 99.9995% purity[2]	NA	NA	NA	2,100	3,260
Per gram, dendritic, metal[3]	185.00	193.60	162.50	208.00	208.00
Per gram, metal, ingot[4]	119.00	124.00	131.00	131.00	131.00
Per gram, scandium acetate, 99.99% purity[5]	68.70	68.70	70.30	74.00	74.00
Per gram, scandium chloride, 99.9% purity[5]	42.40	44.30	48.70	48.70	48.70
Per gram, scandium fluoride, 99.9% purity[5]	180.00	188.20	193.80	193.80	193.80
Per gram, scandium iodide, 99.999% purity[5]	162.00	169.00	174.00	174.00	174.00
Per metric ton, scandium-aluminum alloy[2]	NA	NA	NA	NA	74.00
Net import reliance[6] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2003-06): Not available.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-07**
Mineral substances not elsewhere specified or Included including scandium ores	2530.90.8050	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 remained stable for the lower grades and increased for the higher purities from those of the previous year. The supply of domestic and foreign scandium remained strong to meet increased demand. Although demand increased in 2007, 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 high-strength, lightweight handgun frames and cylinders. New demand is expected to come from future fuel-cell markets and aerospace applications.

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SCANDIUM

Scandium's use continued to increase in metal halide lighting. Scandium, as the metal or the iodide, mixed with other elements, was added to halide light bulbs to adjust the color to simulate natural sunlight. Demand decreased slightly for scandium-aluminum alloys in baseball and softball bats as new composite materials of carbon fiber and carbon nanotube were introduced to the market. Sports equipment remained the leading use of scandium. Future development of alloys for aerospace and specialty markets is expected. Scandium's availability from Kazakhstan, Russia, and Ukraine increased substantially in 1992, after export controls were relaxed, and sales continue to provide the Western World with most of its scandium alloys, compounds, and metal. China also continued to supply scandium compounds and metal to the U.S. market.

World Mine Production, Reserves, and Reserve Base:[7] Scandium was produced as a byproduct material in China, Kazakhstan, Russia, and Ukraine. Foreign mine production data were not available. No scandium was mined in the United States in 2007. Scandium occurs in many ores in trace amounts, but has not been found in sufficient quantities to be considered as 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 because of its lack of affinity to combine with the common ore-forming anions. It is widely dispersed in the lithosphere and forms solid solutions in more than 100 minerals. In the Earth's crust, scandium is primarily a trace constituent of ferromagnesium minerals. Concentrations in these minerals (amphibole-hornblende, biotite, and pyroxene) 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 aluminum phosphate minerals, beryl, cassiterite, columbite, garnet, muscovite, rare-earth minerals, and wolframite. Recent domestic production has primarily been from the scandium-yttrium silicate mineral thortveitite, and from byproduct leach solutions from uranium operations. One of the principal domestic scandium resources is the fluorite tailings from the mined-out Crystal Mountain deposit near Darby, MT. Tailings from the mined-out fluorite operations, which were generated from 1952 to 1971, contain thortveitite and associated scandium-enriched minerals. Resources also are contained in the tantalum residues previously processed at Muskogee, OK. Smaller resources are associated with molybdenum, titanium-tungsten, and tungsten minerals from the Climax molybdenum deposit in Colorado and in crandallite, kolbeckite, and variscite at Fairfield, UT. Other lower grade domestic resources are present in ores of aluminum, cobalt, 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 nickel and cobalt deposits in Syerston and Lake Innes, New South Wales. China's resources are in iron, tin, and tungsten deposits in Fujian, Guangdong, Guangxi, Jiangxi, 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 and carbon nanotube material may substitute in sporting goods, especially baseball and softball bats and bicycle frames.

[e]Estimated. NA Not available.
[1]See also Rare Earths.
[2]Scandium oxide as a white powder and scandium-aluminum master alloy with a 2% scandium metal content in metric quantities from Stanford Materials Corporation.
[3]Scandium pieces, 99.9% purity, distilled dendritic, 2003-07 prices converted from 0.5-gram price, from Alfa Aesar, a Johnson Matthey company.
[4]Metal ingot pieces, 99.9% purity, 2003-07, from Alfa Aesar, a Johnson Matthey company.
[5]Acetate, chloride, and fluoride, in crystalline or crystalline aggregate form and scandium iodide as ultradry powder from Alfa Aesar, a Johnson Matthey company. Fluoride price converted from 5-gram quantity.
[6]Defined as imports – exports + adjustments for Government and industry stock changes.
[7]See Appendix C for definitions.