ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: Zircon sand was produced at two mines in Florida, one mine in Georgia, and two mines in Virginia. A new mine that began operating in Georgia in 2004 produced a mixed heavy-mineral sands concentrate that will be trucked to a dry mill in Florida for separation. Zirconium and hafnium metals were produced from zircon sand by two domestic producers, one in Oregon and the other in Utah. Typically, both metals are in the ore in a zirconium to hafnium ratio of about 50:1. Primary zirconium chemicals were produced by the Oregon metal producer and at a plant in New Jersey. Secondary zirconium chemicals were produced by 10 other companies. Zirconia (ZrO_2) was produced from zircon sand at plants in Alabama, New Hampshire, New York, Ohio, and by the metal producer in Oregon. Zircon ceramics, opacifiers, refractories, and foundry applications are the leading end uses for zirconium. Other end uses of zirconium include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The leading market for hafnium metal is as an addition in superalloys.

Salient Statistics—United States:	**2000**	**2001**	**2002**	**2003**	**2004[e]**
Production, zircon (ZrO_2 content)	W	W	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	42,400	39,400	22,900	24,300	20,300
Zirconium, alloys, waste and scrap, and powder (ZrO_2 content)	1,400	850	750	308	278
Zirconium, waste and scrap, other	628	772	533	631	714
Zirconium oxide (ZrO_2 content)[1]	3,950	2,950	2,900	2,350	4,180
Hafnium, unwrought, waste and scrap	11	5	5	5	3
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	47,400	43,500	30,600	45,900	41,000
Zirconium, alloys, waste and scrap, and powder (ZrO_2 content)	243	251	281	276	373
Zirconium, waste and scrap, other	1,410	1,660	1,940	2,010	1,940
Zirconium oxide (ZrO_2 content)[1]	1,680	2,100	2,400	1,520	1,600
Consumption, zirconium ores and concentrates, apparent (ZrO_2 content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic[2]	340	340	350	360	400
Imported, f.o.b.[3]	396	356	397	396	440
Zirconium sponge, dollars per kilogram[4]	20-26	20-31	20-31	20-31	30-66
Hafnium sponge, dollars per kilogram[4]	165-209	119-141	119-141	119-141	326
Net import reliance[5] as a percentage of apparent consumption:					
Zirconium	E	E	E	E	E
Hafnium	NA	NA	NA	NA	NA

Recycling: Scrap zirconium metal and alloys was recycled by four companies, one each in California, Michigan, New York, and Texas. In-plant recycled zirconium came from scrap generated during metal production and fabrication and was recycled by companies in Oregon and Utah. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Recycling of hafnium metal was insignificant.

Import Sources (2000-03):[6] Zirconium ores and concentrates: Australia, 46%; South Africa, 38%; and other, 16%. Zirconium, unwrought, powder: Germany, 58%; Canada, 22%; Argentina, 3%; China, 3%; and other, 14%. Hafnium, unwrought, including powder: France, 50%; Canada, 30%; China, 10%; and Japan, 10%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-04**
Zirconium ores and concentrates	2615.10.0000	Free.
Germanium oxides and zirconium dioxide	2825.60.0000	3.7% ad val.
Ferrozirconium	7202.99.1000	4.2% ad val.
Zirconium, unwrought, zirconium powders	8109.20.0000	4.2% ad val.
Zirconium waste and scrap	8109.30.0000	Free.
Zirconium, articles, nesoi	8109.90.0000	3.7% ad val.
Hafnium, unwrought, hafnium powders	8112.92.2000	Free.

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Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: The demand for zirconium mineral concentrates was higher than the supply in 2004. The cause of the shortage was the result of several issues including increased demand, the closure of several zircon-producing mines, reduced zircon grades at a few mines, and the transfer of mining equipment from mined-out sites to new mining locations. Higher zircon output is expected in 2005, especially in the United States and South Africa. In 2004, U.S. imports of zirconium ores and concentrates (mostly zircon) decreased about 16%, while exports decreased 11%. The main ore body at Green Cove Springs, FL, was mined out, and satellite mining methods were instituted to recover remaining isolated pockets of heavy-mineral sands in the surrounding area. A new heavy-mineral sands mine began operating at Lulaton, GA, that will replace the production lost from the Green Cove Springs, FL, location. In Virginia, an expansion of processing facilities and the addition of a new mine, the Concord, adjacent to the Old Hickory Mine, was completed. The availability of hafnium, produced as a byproduct during zirconium metal processing, continued to exceed demand. Russia was the sole producer of baddeleyite in 2004.

World Mine Production, Reserves, and Reserve Base: World primary hafnium production statistics are not available. Hafnium occurs with zirconium in the minerals zircon and baddeleyite.

	Zirconium				Hafnium	
	Mine production (thousand metric tons)		Reserves[7] (million metric tons, ZrO_2)	Reserve base[7]	Reserves[7] (thousand metric tons, HfO_2)	Reserve base[7]
	2003	2004[e]				
United States[1]	W	W	3.4	5.3	68	97
Australia	462	450	9.1	30	180	600
Brazil	21	22	2.2	4.6	44	91
China	15	15	0.5	3.7	NA	NA
India	20	20	3.4	3.8	42	46
South Africa	300	302	14	14	280	290
Ukraine	35	35	4.0	6.0	NA	NA
Other countries	11	11	0.9	4.1	NA	NA
World total (rounded)	860	860	38	72	610	1,100

World Resources: Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate and sand and gravel deposits have the potential to yield substantial amounts of zircon as a future byproduct. Eudialyte and gittinsite are zirconium silicate minerals that have a potential for zirconia production. Identified world resources of zircon exceed 60 million tons.

Resources of hafnium in the United States are estimated to be about 130,000 tons, available in the 14-million-ton domestic resources of zircon. World resources of hafnium are associated with those of zircon and baddeleyite and exceed 1 million tons.

Substitutes: Chromite and olivine can be used instead of zircon for some foundry applications. Dolomite and spinel refractories can also substitute for zircon in certain high-temperature applications. Columbium (niobium), stainless steel, and tantalum provide limited substitution in nuclear applications, while titanium and synthetic materials may substitute in some chemical plant uses.

Silver-cadmium-indium control rods are used in lieu of hafnium at numerous nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys; in others, only hafnium produces the desired or required grain boundary refinement.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Includes germanium oxides and zirconium oxides.
[2]E.I. du Pont de Nemours & Co. and Iluka Resources, Inc., average price.
[3]U.S. Census Bureau trade data.
[4]American Metal Market, daily, Miscellaneous prices. Converted from pounds.
[5]Defined as imports – exports.
[6]Data for the new trade categories "Zirconium, unwrought, powder" and "Hafnium, unwrought, including powder" are based on 2002-03 only.
[7]See Appendix C for definitions.