ZIRCONIUM AND HAFNIUM

(Data in metric tons, unless otherwise noted)

Domestic Production and Use: Zircon sand was produced at two mines in Florida and at one mine in Virginia. Zirconium and hafnium metal 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 Zr to Hf ratio of 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 largest end uses for zirconium. Other end uses of zirconium include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The largest market for hafnium metal is as an addition in superalloys.

Salient Statistics—United States:	1997	1998	1999	2000	2001e
Production: Zircon (ZrO_2 content)[1]	100,000	100,000	100,000	100,000	100,000
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	40,600	58,200	37,500	42,400	40,000
Zirconium, alloys, waste and scrap (ZrO_2 content)	929	1,210	1,160	1,400	1,100
Zirconium oxide (ZrO_2 content)[2]	4,220	3,900	3,140	3,950	3,300
Hafnium, unwrought, waste and scrap	8	12	9	11	8
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	28,800	26,600	45,200	47,400	38,300
Zirconium, alloys, waste and scrap (ZrO_2 content)	188	216	211	259	280
Zirconium oxide (ZrO_2 content)[2]	1,970	1,540	1,680	2,100	2,600
Consumption, zirconium ores and concentrates, apparent (ZrO_2 content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic[3]	419	320	300	340	350
Imported, f.o.b.[4]	445	355	311	396	370
Zirconium sponge, dollars per kilogram[5]	20-26	20-26	20-26	20-26	20-26
Hafnium sponge, dollars per kilogram[5]	165-209	165-209	165-209	165-209	165-209
Net import reliance[6] as a percentage of apparent consumption:					
Zirconium	W	W	W	W	W
Hafnium	NA	NA	NA	NA	NA

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

Import Sources (1997-2000): Zirconium ores and concentrates: South Africa, 55%; Australia, 41%; and other, 4%. Zirconium, wrought, unwrought, waste and scrap: France, 68%; Germany, 14%; Japan, 6%; Canada, 4%; and other, 8%. Hafnium, unwrought, waste and scrap: France, 82%; Germany, 7%; United Kingdom, 2%; and other, 9%.

Tariff: Item	Number	Normal Trade Relations 12/31/01
Zirconium ores and concentrates	2615.10.0000	Free.
Germanium oxides and ZrO_2	2825.60.0000	3.7% ad val.
Ferrozirconium	7202.99.1000	4.2% ad val.
Zirconium, waste and scrap	8109.10.3000	Free.
Zirconium, other unwrought, powders	8109.10.6000	4.2% ad val.
Zirconium, other wrought, alloys	8109.90.0000	3.7% ad val.
Unwrought hafnium, waste and scrap	8112.91.2000	Free.

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

Government Stockpile: In addition to 15,726 tons of baddeleyite ore (gross weight) held in the National Defense Stockpile, the U.S. Department of Energy (DOE) held over 500 tons of zirconium in various forms. DOE also maintained a stockpile of approximately 35 tons of hafnium.

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ZIRCONIUM AND HAFNIUM

Stockpile Status—9-30-01[7]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2001	Disposals FY 2001
Baddeleyite	—	—	—	17,383	—

Events, Trends, and Issues: The global supply and demand of zirconium mineral concentrates was largely balanced in 2001. This trend is expected to continue over the next few years. In the long-term, however, supply shortages may occur unless new production sources of zirconium concentrates are developed. U.S. imports of zirconium ores and concentrates were estimated to have decreased 55%, while exports increased 44% compared with those of 2000. A mining operation at Stony Creek, VA, began production of zircon and other heavy minerals in 1998. Initial capacity was expected to include up to 30,000 tons per year of zircon. An expansion at the mine began in 2001 with completion scheduled for 2002. The availability of hafnium continued to exceed supply. Surpluses were stockpiled in the form of hafnium oxide. The demand for nuclear-grade zirconium metal, the production of which necessitates hafnium's removal, produces more hafnium than can be consumed by the metal's markets.

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[8] (million metric tons, ZrO_2)	Reserve base[8] (million metric tons, ZrO_2)	Reserves[8] (thousand metric tons, HfO_2)	Reserve base[8] (thousand metric tons, HfO_2)
	2000	2001[e]				
United States[1]	100	100	3.4	5.3	68	97
Australia	400	400	9.1	30.08	180	600
Brazil	19	30	1.9	1.9	7	7
China	[e]15	15	0.5	1.0	NA	NA
India	19	19	3.4	3.8	42	46
South Africa	400	300	14.0	14.0	260	260
Ukraine	[e]65	75	4.0	6.0	NA	NA
Other countries	23	30	0.9	4.1	NA	NA
World total (may be rounded)	1,040	1,070	36	65	560	1,000

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. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]Rounded to one significant digit to avoid revealing company proprietary data. ZrO_2 content of zircon is typically 65%.

[2]Includes germanium oxides and zirconium oxides.

[3]E.I. du Pont de Nemours & Co. Inc. and Iluka Resources, Inc., average price.

[4]U.S. Census Bureau trade data.

[5]American Metal Market, daily, Miscellaneous prices. Converted from pounds.

[6]Defined as imports - exports.

[7]See Appendix B for definitions.

[8]See Appendix C for definitions.