ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: The zirconium-silicate mineral zircon is produced as a coproduct from the mining and processing of heavy minerals. Two firms produced zircon from surface-mining operations in Florida and Virginia. Zirconium and hafnium metal were produced from zircon by two domestic producers, one in Oregon and the other in Utah. Typically, both elements are in the ore in a zirconium-to-hafnium ratio of about 50:1. Zirconium chemicals were produced by the metal producer in Oregon and by at least 11 other companies. Zirconia (ZrO_2) was produced from zircon at plants in Alabama, New Hampshire, New Jersey, New York, Ohio, Tennessee, and by the metal producer in Oregon. Ceramics, opacifiers, refractories, and foundry applications are the leading end uses for zircon. Other end uses of zircon include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The leading consumers of zirconium and hafnium metal are the nuclear energy and chemical process industries.

Salient Statistics—United States:	**2003**	**2004**	**2005**	**2006**	**2007[e]**
Production, zircon (ZrO_2 content)	W	W	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	24,300	22,900	24,800	23,500	19,000
Zirconium, unwrought, powder, and waste and scrap	75	89	283	256	223
Zirconium, wrought	468	708	741	492	484
Zirconium oxide[1]	2,350	3,960	3,160	2,820	3,800
Hafnium, unwrought, waste and scrap	5	4	4	4	4
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	45,900	44,700	65,600	49,600	48,100
Zirconium, unwrought, powder, and waste and scrap	204	233	321	271	287
Zirconium, wrought	1,490	1,470	1,650	1,610	1,720
Zirconium oxide[1]	1,520	1,600	2,260	3,340	2,270
Consumption, zirconium ores and concentrates, apparent (ZrO_2 content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic[2]	360	557	570	785	840
Imported, f.o.b.[3]	396	477	674	791	900
Zirconium, unwrought, dollars per kilogram[3]	44	31	22	23	25
Hafnium, unwrought, dollars per kilogram[3]	195	223	235	194	232
Net import reliance[4] as a percentage of apparent consumption:					
Zirconium	E	E	E	E	E
Hafnium	NA	NA	NA	NA	NA

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

Import Sources (2003-06): Zirconium ores and concentrates: Australia, 61%; South Africa, 32%; China, 4%; Canada, 2%; and other, 1%. Zirconium, unwrought, including powder: France, 60%; Germany, 25%; China, 10%; and other, 5%. Hafnium, unwrought: France, 73%; Canada, 23%; Germany, 2%; Austria, 1%; and other, 1%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-07**
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.
Other zirconium articles	8109.90.0000	3.7% ad val.
Hafnium, unwrought, hafnium powders	8112.92.2000	Free.

Prepared by **Joseph Gambogi [(703) 648-7718, jgambogi@usgs.gov, fax: (703) 648-7757]**

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

Government Stockpile: None.

Events, Trends, and Issues: Domestic consumption of zirconium mineral concentrates decreased slightly compared with that of 2006. Although consumption of zircon for use in television glass decreased significantly, consumption of zircon increased for ceramic, refractory, and chemical uses. Cost-cutting measures ended mining in Green Cove Springs, FL, and Lulaton, GA; however, reprocessing of tailings for zircon continued.

Global production of zirconium concentrates increased to 1.24 million tons, a 5% increase compared with that of 2006. Prices for zircon concentrate increased to record-high levels. Global consumption of zircon was forecast to increase an average of 3% per year through 2015. Consumption growth in China was expected to be somewhat higher than the global average. In 2007, new mine production began in Australia (Murray Basin, Tiwi Islands), Indonesia (Kalimantan), Mozambique (Moma), and The Gambia (Sanyang). Projects that were nearing completion included those in Australia (Keysbrook) and South Africa (Tormin). Projects were also being developed in Australia (Coburn Sands, Donald, Eucla Basin, and Murray Basin), Canada (Athabasca Oil Sands), India (Tamil Nadu), Kenya (Kwale), Madagascar (Fort Dauphin), Mozambique (Corridor Sands), Senegal (Grande Côte), and South Africa (Xolobeni). The availability of hafnium, produced as a byproduct during zirconium metal processing, continued to exceed demand.

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[5] (million metric tons, ZrO_2)	Reserve base[5] (million metric tons, ZrO_2)	Reserves[5] (thousand metric tons, HfO_2)	Reserve base[5] (thousand metric tons, HfO_2)
	2006	2007[e]				
United States	W	W	3.4	5.7	68	97
Australia	491	550	9.1	30	180	600
Brazil	26	26	2.2	4.6	44	91
China	170	170	0.5	3.7	NA	NA
India	21	21	3.4	3.8	42	46
South Africa	398	405	14	14	280	290
Ukraine	35	35	4.0	6.0	NA	NA
Other countries	38	32	0.9	4.1	NA	NA
World total (rounded)	1,180	1,240	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. Niobium (columbium), 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]Unit value based on U.S. imports for consumption.
[4]Defined as imports – exports.
[5]See Appendix C for definitions.