

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 (ZrO₂) was produced from zircon at plants in Alabama, New Hampshire, New Jersey, New York, Ohio, Tennessee, and by the metal producer in Oregon. Ceramics, foundry applications, opacifiers, and refractories 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:	2004	2005	2006	2007	2008^e
Production, zircon (ZrO ₂ content)	W	W	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO ₂ content)	22,900	24,800	23,500	13,000	23,000
Zirconium, unwrought, powder, and waste and scrap	89	283	256	299	352
Zirconium, wrought	708	741	492	485	431
Zirconium oxide ¹	3,960	3,160	2,820	3,740	5,240
Hafnium, unwrought, waste and scrap	4	4	4	4	10
Exports:					
Zirconium ores and concentrates (ZrO ₂ content)	44,700	65,600	49,600	43,000	34,100
Zirconium, unwrought, powder, and waste and scrap	233	321	271	328	687
Zirconium, wrought	1,470	1,650	1,610	1,830	1,910
Zirconium oxide ¹	1,600	2,260	3,340	2,400	3,310
Consumption, zirconium ores and concentrates, apparent (ZrO ₂ content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic ²	502	570	785	763	790
Imported, f.o.b. ³	477	674	791	872	890
Zirconium, unwrought, dollars per kilogram ³	31	22	23	24	32
Hafnium, unwrought, dollars per kilogram ³	223	235	194	250	289
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 was 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 (2004-07): Zirconium ores and concentrates: Australia, 57%; South Africa, 37%; China, 3%; Canada, 1%; and other, 2%. Zirconium, unwrought, including powder: France, 60%; Germany, 26%; China, 9%; and other, 5%. Hafnium, unwrought: France, 65%; Canada, 21%; United Kingdom, 5%; and other, 9%.

Tariff:	Item	Number	Normal Trade Relations
			12-31-08
	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.

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

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Government Stockpile: None.

Events, Trends, and Issues: Domestic consumption of zirconium mineral concentrates decreased slightly compared with that of 2007. The reprocessing of tailings to recover zircon continued in Green Cove Springs, FL, despite the cessation of mining in 2007. Domestic mining of heavy minerals continued in Stony Creek, VA, and Starke, FL.

In 2008, global production of zirconium concentrates decreased about 5% compared with that of 2007. Production difficulties in Australia, Indonesia, and Mozambique limited the availability of zirconium mineral concentrates. Owing to constrained supply, 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; however, the global financial instabilities in 2008 increased the uncertainty of this forecast. Consumption growth in China was expected to continue to lead the global average.

Heavy mineral exploration and mining projects were underway in Australia, Canada, India, Kenya, Madagascar, Mozambique, Russia, Senegal, and South Africa. 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. The reserves and reserve base estimates for Australia and "Other countries" have been revised based on new information from government and company reports.

	Zirconium			Hafnium		
	Mine production	Reserves ⁵	Reserve base ⁵	Reserves ⁵	Reserve base ⁵	
	(thousand metric tons)	(million metric tons, ZrO ₂)		(thousand metric tons, HfO ₂)		
	<u>2007</u>	<u>2008^e</u>				
United States	W	W	3.4	5.7	68	97
Australia	605	575	20	35	180	600
Brazil	31	31	2.2	4.6	44	91
China	180	160	0.5	3.7	NA	NA
India	29	29	3.4	3.8	42	46
South Africa	400	405	14	14	280	290
Ukraine	35	35	4.0	6.0	NA	NA
Other countries	145	120	3.5	4.2	NA	NA
World total (rounded)	1,430	1,360	51	77	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.

^eEstimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.

¹Includes germanium oxides and zirconium oxides.

²Yearend average price.

³Unit value based on U.S. imports for consumption.

⁴Defined as imports – exports.

⁵See Appendix C for definitions.