

## ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

**Domestic Production and Use:** In 2015, three firms recovered zircon (zirconium silicate) from surface-mining operations in Florida, Georgia, and Virginia as a coproduct from the mining and processing of heavy minerals. Zirconium metal and hafnium metal were produced from zirconium chemical intermediates by one domestic producer in Oregon and one in Utah. Typically, zirconium and hafnium are contained in zircon at a ratio of about 50 to 1. Zirconium chemicals were produced by the metal producer in Oregon and by at least 10 other companies. Ceramics, foundry sand applications, opacifiers, and refractories are the leading end uses for zircon. Other end uses of zircon include abrasives, chemicals (predominantly, zirconium oxychloride octohydrate and zirconium basic sulfate as intermediate chemicals), metal alloys, and welding rod coatings. The leading consumers of zirconium metal and hafnium metal are the nuclear energy and chemical process industries.

<b>Salient Statistics—United States:</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015<sup>e</sup></b>
Production, zircon (ZrO <sub>2</sub> content)	W	W	W	W	<sup>1</sup> 60,000
Imports:					
Zirconium, ores and concentrates (ZrO <sub>2</sub> content)	17,200	16,700	8,050	32,800	20,700
Zirconium, unwrought, powder, and waste and scrap	487	279	395	843	1,400
Zirconium, wrought	390	288	321	257	195
Hafnium, unwrought, powder, and waste and scrap	10	24	10	21	55
Exports:					
Zirconium ores and concentrates (ZrO <sub>2</sub> content)	15,800	13,000	19,000	4,850	2,830
Zirconium, unwrought, powder, and waste and scrap	677	554	600	534	470
Zirconium, wrought	1,330	1,250	1,140	913	1,030
Consumption, apparent, zirconium ores and concentrates, (ZrO <sub>2</sub> content)	W	W	W	W	80,000
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic <sup>2</sup>	2,650	2,650	1,050	1,050	1,050
Imported <sup>3</sup>	2,122	2,533	996	1,106	1,052
Zirconium, unwrought, import, France, dollars per kilogram <sup>4</sup>	64	91	75	59	86
Hafnium, unwrought, import, France, dollars per kilogram <sup>4</sup>	544	503	578	561	608

Net import reliance<sup>5</sup> as a percentage of apparent consumption:

Zirconium	<10%	<10%	E	<50%	<25%
Hafnium	NA	NA	NA	NA	NA

**Recycling:** Companies in Oregon and Utah recycled zirconium from new scrap generated during metal production and fabrication and/or from post-commercial old scrap. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Hafnium metal recycling was insignificant.

**Import Sources (2011–14):** Zirconium mineral concentrates: South Africa, 67%; Australia, 28%; and other, 5%. Zirconium, unwrought, including powder: China, 44%; Japan, 30%; Germany, 20%; France, 4%; and other, 2%. Hafnium, unwrought: France, 47%; Germany, 28%; Australia, 17%; United Kingdom, 5%; and other, 3%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–15</b>
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 and zirconium powder	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, powder, and waste and scrap	8112.92.2000	Free.

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

**Government Stockpile:** None.

## ZIRCONIUM AND HAFNIUM

**Events, Trends, and Issues:** Domestic mining of zirconium ores and production of concentrates took place at two mines near Stony Creek, VA; one near Starke, FL; and one near Nahunta, GA. Prices for zircon concentrates remained constant throughout the year. U.S. imports of ores and concentrates decreased by about 38% and exports decreased by 42% because end users adjusted to the forthcoming idling of operations in Virginia and commencement of mineral processing operations in Georgia. The operator of the two Virginia mines expected to extract the remaining ore from both mines and complete operations by yearend 2015. The operator of the mine in Georgia was developing a second mine in Brantley County and completed construction of a mineral sand plant near Offerman to process heavy-mineral concentrates from these mines. A fourth company was planning to process tailings from mineral sand mines in New Jersey to produce zircon and titanium concentrates. Construction of a mineral sands concentrator was expected to be complete by the second quarter of 2016. Global production of zirconium concentrates (excluding the United States) was estimated to have decreased by 5% compared with that of 2014. According to the leading world producer, global consumption of zirconium concentrates during the first half of 2015 was essentially unchanged from that in the first half of 2014, and modest year-over-year gains in consumption were expected in the second half of 2015. Heavy-mineral exploration and mining projects were underway in Australia, Madagascar, Mozambique, Sri Lanka, and Tanzania.

**World Mine Production and Reserves:** World primary hafnium production data are not available. Although hafnium occurs with zirconium in the minerals zircon and baddeleyite, quantitative estimates of hafnium reserves are not available.

	Zirconium mine production (thousand metric tons, gross weight)		Zirconium reserves <sup>6</sup> (thousand metric tons, ZrO <sub>2</sub> )
	2014	2015 <sup>e</sup>	
United States	W	60	500
Australia	551	500	51,000
China	150	140	500
India	40	40	3,400
Indonesia	110	110	NA
Mozambique	51	50	1,100
South Africa	387	380	14,000
Other countries	130	130	7,200
World total (rounded)	71,420	1,410	78,000

**World Resources:** Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate rock and sand and gravel deposits could potentially yield substantial amounts of zircon as a byproduct. World resources of hafnium are associated with those of zircon and baddeleyite. Quantitative estimates of hafnium resources are not available.

**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, and titanium and synthetic materials may substitute in some chemical processing plant applications. 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.

<sup>e</sup>Estimated. E Net Exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup> Rounded to one significant digit to avoid disclosing company proprietary data.

<sup>2</sup> Source: Industrial Minerals, yearend average of high-low price range.

<sup>3</sup> Unit value based on U.S. imports for consumption from Australia and South Africa.

<sup>4</sup> Unit value based on U.S. imports for consumption from France.

<sup>5</sup> Defined as imports – exports.

<sup>6</sup> See [Appendix C](#) for resource/reserve definitions and information concerning data sources.

<sup>7</sup> Excludes U.S. production.