ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2019, two firms recovered zircon (zirconium silicate) from surface-mining operations in Florida and Georgia as a coproduct from the mining of heavy-mineral sands and the processing of titanium and zirconium mineral concentrates, and a third company processed existing mineral sands tailings in Florida. Zirconium metal and hafnium metal were produced from zirconium chemical intermediates by one producer in Oregon and one in Utah. Zirconium and hafnium are typically contained in zircon at a ratio of about 36 to 1. Zirconium chemicals were produced by the metal producer in Oregon and by at least 10 other companies. Ceramics, foundry sand, opacifiers, and refractories are the leading end uses for zircon. Other end uses of zircon include abrasives, chemicals (predominantly, zirconium basic sulfate and zirconium oxychloride octohydrate as intermediate chemicals), metal alloys, and welding rod coatings. The leading consumers of zirconium metal are the chemical process and nuclear energy industries. The leading use of hafnium metal is in superalloys.

Salient Statistics—United States:	**2015**	**2016**	**2017**	**2018**	**2019e**
Production, zirconium ores and concentrates (ZrO_2 content)[1]	[2]50,000	W	[2]50,000	[2]100,000	[2]100,000
Imports:					
Zirconium ores and concentrates (ZrO_2 content)	20,800	24,900	24,300	26,400	24,000
Zirconium, unwrought, powder, and waste and scrap	1,140	1,040	899	1,880	2,200
Zirconium, wrought	188	195	282	284	320
Hafnium, unwrought, powder, and waste and scrap	72	180	113	41	30
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	3,200	3,280	31,500	77,500	52,000
Zirconium, unwrought, powder, and waste and scrap	515	363	627	556	730
Zirconium, wrought	1,020	788	972	1,150	950
Consumption, apparent, zirconium ores and concentrates, (ZrO_2 content)[3]	[2]70,000	W	[2]40,000	[2]50,000	[2]50,000
Prices:					
Zircon, dollars per metric ton (gross weight):					
Australia, free on board[4]	1,025	975	975	NA	NA
China, cost insurance and freight[5]	NA	NA	1,295	1,625	1,630
Imported[6]	1,061	877	916	1,290	1,500
Zirconium, unwrought, import, China, dollars per kilogram[7]	15	33	12	13	16
Hafnium, unwrought, dollars per kilogram[5]	1,250	930	900	840	830
Net import reliance[8] as a percentage of apparent consumption:					
Zirconium ores and concentrates	<25	<50	E	E	E
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 (2015–18): Zirconium ores and concentrates: South Africa, 53%; Senegal, 28%; Australia, 15%; Russia, 2%; and other, 2%. Zirconium, unwrought, including powder: China, 78%; Germany, 14%; Japan, 5%; France, 2%; and other, 1%. Hafnium, unwrought: Germany, 45%; France, 29%; China, 15%; United Kingdom, 11%; and other, <1%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–19**
Zirconium ores and concentrates	2615.10.0000	Free.
Ferrozirconium	7202.99.1000	4.2% ad val.
Zirconium, unwrought and 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.

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

Government Stockpile: None.

Events, Trends, and Issues: The average unit value for imports of zircon concentrates increased for the third year in a row. The average unit value for exports of zircon concentrates rose slightly in 2019 compared with 2018.

In China, zircon production was estimated to have decreased significantly. It was reported that China began conducting environmental inspections in July in the Provinces of Chongqing, Fujian, Gansu, Hainan, Qinghai, and Shanghai, which resulted in mine and plant closures, including zircon mines in Hainan Province. It was uncertain how long the mines and plants would be closed.

During 2019, several large mining projects with zirconium were in development but construction had not begun on any them. In Western Australia, the Thunderbird mineral sands project received full permitting, secured a 15-year agreement with a provider of liquified natural gas, and was seeking full funding of the project. In New South Wales, Australia, the Dubbo polymetallic project also received full permitting and was seeking funding. In Siberia, construction was to begin in the second half of 2019 at the Tugan titanium-zirconium deposit but concerns regarding funding delayed the start of work.

World Mine Production and Reserves: World primary hafnium production data are not available and quantitative estimates of hafnium reserves are not available. Zirconium reserves for Kenya and South Africa were revised based on company reporting.

	Zirconium ores and concentrates, mine production (thousand metric tons, gross weight)		Zirconium reserves[9] (thousand metric tons, ZrO_2 content)
	2018	2019[e]	
United States	[2]100	[2]100	500
Australia	560	550	[10]42,000
China	140	80	500
Kenya	45	50	120
Mozambique	48	50	1,800
Senegal	64	70	NA
South Africa	350	370	6,500
Other countries	170	170	11,000
World total (rounded)	1,480	1,400	62,000

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.

[e]Estimated. E Net Exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Contained ZrO_2 content calculated at 65% of gross production.
[2]Rounded to one significant digit to avoid disclosing company proprietary data.
[3]Defined as production + imports – exports.
[4]Source: Industrial Minerals, average of yearend price. Prices of zircon from Australia were discontinued at yearend 2017.
[5]Source: Argus Media group–Argus Metals International, average of yearend price.
[6]Unit value based on annual United States imports for consumption from Australia, Senegal, and South Africa.
[7]Unit value based on annual United States imports for consumption from China.
[8]Defined as imports – exports.
[9]See Appendix C for resource and reserve definitions and information concerning data sources.
[10]For Australia, Joint Ore Reserves Committee-compliant reserves were 13 million tons.