

ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2020, one firm 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 second 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:

	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020^e</u>
Production, zirconium ores and concentrates (ZrO ₂ content) ¹	W	² 50,000	³ 100,000	³ 100,000	³ <100,000
Imports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	24,900	24,300	26,400	22,600	20,000
Zirconium, unwrought, powder, and waste and scrap	1,040	899	1,880	1,820	3,000
Zirconium, wrought	195	282	284	289	300
Hafnium, unwrought, powder, and waste and scrap	180	113	41	32	20
Exports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	3,280	31,500	77,500	40,500	14,000
Zirconium, unwrought, powder, and waste and scrap	363	627	556	897	780
Zirconium, wrought	788	972	1,150	867	850
Consumption, apparent, ⁴ zirconium ores and concentrates (ZrO ₂ content) ¹	W	² 50,000	³ 100,000	³ 100,000	³ <100,000
Price:					
Zircon, dollars per metric ton (gross weight):					
Australia, free on board ⁵	975	975	NA	NA	NA
China, cost insurance and freight ⁶	NA	1,295	1,625	1,585	1,500
Imported ⁷	877	916	1,290	1,490	1,400
Zirconium, unwrought, import, China, ⁸ dollars per kilogram	33	12	13	14	6
Hafnium, unwrought, ⁶ dollars per kilogram	930	900	840	780	750
Net import reliance ⁹ as a percentage of apparent consumption:					
Zirconium ores and concentrates	<50	E	E	E	<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 (2016–19): Zirconium ores and concentrates: South Africa, 55%; Senegal, 26%; Australia, 15%; Russia, 1%; and other, 3%. Zirconium, unwrought, including powder: China, 81%; Germany, 12%; Japan, 3%; France, 2%; and other, 2%. Zirconium, wrought: France, 63%; Germany, 18%; Belgium, 5%; Canada, 4%; and other, 10%. Hafnium, unwrought: Germany, 45%; France, 31%; China, 17%; the United Kingdom, 5%; and other, 2%.

<u>Tariff:</u>	<u>Item</u>	<u>Number</u>	<u>Normal Trade Relations</u> <u>12–31–20</u>
	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.

Depletion Allowance: 22% (domestic), 14% (foreign).

Government Stockpile: None.

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Events, Trends, and Issues: The average unit value for imports of zircon concentrates decreased in 2020 after increasing for the past 3 years. Exports of zirconium ores and zircon concentrates decreased by an estimated 65% in 2020 from those in 2019. In August, new mining and heavy-mineral-processing operations were being commissioned near Jessup, GA.

Global zircon production was estimated to have decreased slightly in 2020 owing to the impact of the COVID-19 pandemic, reduced consumption, and power and labor issues.

During 2020, several large mining projects containing zirconium were in development but construction had not begun on any of them. In Western Australia, two companies announced a potential joint venture that would provide the funding needed for the first stage of construction at the Thunderbird mineral sands project if final agreements and approvals were reached. Regional or national government agencies in Australia indicated that they would provide financial support, such as loans, for the Coburn mineral sands project in Western Australia and the Dubbo polymetallic project in New South Wales.

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 Australia were revised on the basis of Government reports. Zirconium reserves for Kenya and South Africa were revised on the basis of company reports.

	Zirconium ores and zircon concentrates, mine production (thousand metric tons, gross weight)		Zirconium reserves ¹⁰ (thousand metric tons, ZrO ₂ content) ¹
	2019	2020 ^e	
United States	³ 100	³ <100	500
Australia	470	480	¹¹ 43,000
China	140	140	500
Indonesia	34	60	NA
Kenya	29	25	55
Mozambique	100	125	1,800
Senegal	65	65	NA
South Africa	370	320	6,700
Other countries	112	110	11,000
World total (rounded)	1,420	1,400	64,000

World Resources:¹⁰ 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.

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

¹Calculated ZrO₂ content as 65% of gross production.

²Rounded to one significant digit to avoid disclosing company proprietary data.

³Rounded to nearest 100,000 to avoid disclosing company proprietary data.

⁴Defined as production + imports – exports.

⁵Source: Industrial Minerals, average of yearend price. Prices of zircon from Australia were discontinued at yearend 2017.

⁶Source: Argus Media group—Argus Metals International, average of yearend price.

⁷Unit value based on annual United States imports for consumption from Australia, Senegal, and South Africa.

⁸Unit value based on annual United States imports for consumption from China.

⁹Defined as imports – exports.

¹⁰See Appendix C for resource and reserve definitions and information concerning data sources.

¹¹For Australia, Joint Ore Reserves Committee-compliant reserves were 22.1 million tons gross weight.